



75-5  
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U.S. Department of  
Transportation

National Highway  
Traffic Safety  
Administration



*Shelve in Stacks  
S.B.T.*

# Highway Safety Literature

...A MONTHLY ABSTRACT JOURNAL

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Order by title and SAE report number.

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## **ABSTRACT CITATIONS**

HS-015 668

#### **DRIVER INJURY IN AUTOMOBILE ACCIDENTS INVOLVING CERTAIN CAR MODELS: AN UPDATE**

Driver injuries sustained in crashes of passenger cars of known make and model are examined in an update of an earlier study. The procedures are summarized and significant modifications of the earlier methods are discussed. A series of tables lists, by individual make-model groups, the all-injury and severe-plus-killed (A 0 K)-injury indices and associated Chi-square values along with the various sample sizes. The observed frequencies are non-integral due to the reallocation required by the adjustment procedure. One table lists within model year all of the make-year combinations cited previously, ranked by (A 0 K)-injury index number. The same general results indicated by Campbell (1970) obtain. There is evidence of differences among various make-model groups in the frequency and severity of resulting driver injuries. For some individual cars, the relative frequency of driver injuries is significantly higher than the comparable value for the aggregate of all cars. For some cars the injuries are twice the aggregate of all cars. Some cars are associated with driver injuries that are significantly lower than the average value. Generally, the lighter, smaller cars fare worse than their heavier counterparts, although the question of relative accident involvement by make and model must be explored to supplement the results of this study of injury consequences, given that an accident has occurred.

by B. J. Campbell  
North Carolina Univ., Chapel Hill. Hwy. Safety Res. Center  
1974 ; 109p 1ref  
Sponsored by the Insurance Inst. for Hwy. Safety. Original study, dtd. Jul-1970, is HS-009 385.  
Availability: Corporate author

HS-015 669

#### **AN INVESTIGATION OF FACTORS AFFECTING THE USE OF BUSES BY BOTH ELDERLY AND AMBULANT DISABLED PERSONS**

The relevant anthropomorphic dimensions of 100 elderly people and 100 patients with neurological and orthopedic disabilities were recorded. The abilities of the same subjects to negotiate steps of various heights, to pull, twist and reach with their arms were recorded together with their preferences for various seating arrangements and hand holds. The height of entry and exit steps seems to be the dimension that has the most effect on current bus usage by that part of the population represented by this sample. The effective use of handholds to maintain balance may be difficult for some subjects in a moving bus. Photographs of the mock-up bus body used in the tests are included. Results are tabulated in detail.

by B. M. Brooks; H. P. Ruffell-Smith; J. S. Ward  
British Leyland U. K. Ltd., England Truck and Bus Div.  
Contract TRRL-CON/3140/32  
1977 ; 113p 5refs  
Prepared for the Transport and Road Res. Lab., Dept. of the Environment.  
Availability: Transport and Road Res. Lab., Dept. of the Environment, Crowthorne, Berks., England

HS-015 670

#### **INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, TROY, MICHIGAN, JULY 10-12, 1974**

Various aspects of occupant protection were examined by conference participants. Topics included: energy basis for collision severity; automotive recorder research; exact accident data acquisition on scene; statistical analysis; energy absorbing automotive structures using scale model test techniques; front end structures crash response; crash energy management in compact automobiles; a new radar concept (BARBI) for precollision sensing; fluid crash sensor; air bag development; human volunteer and anthropomorphic dummy tests of driver air cushions and passive belt restraint systems; NHTSA efforts in advanced passive protection and child restraint system developments; safety belt webbing; three-point belt system; Army aircrew personnel restraints; scale model testing; test sled simulation; human chest impact protection criteria; and dummy development.

Society of Automotive Engineers, Inc.  
Rept. No. SAE-P-53 ; 1974 ; 425p refs  
Sponsored by the Passenger Protection Com., SAE  
Automobile Body Activity Safety Com., and SAE Passenger Car Activity. Includes HS-015 671--HS-015 697.  
Availability: SAE

HS-015 671

#### **ENERGY BASIS FOR COLLISION SEVERITY**

An objective technique is presented for estimating the severity of automobile collisions. The vehicle damage and the dynamic force-deflection characteristics of the vehicle structure are used to estimate the energy absorbed in plastic deformation of the vehicle. This energy can then be expressed as an equivalent barrier speed (EBS). The development is limited to frontal damage, although the technique is general and could be extended to side and rear damage. Data are presented relating residual crush and impact speed for full frontal barrier tests to provide the basis for a simple model of the force-deflection characteristics of vehicle front structures. EBS is then estimated by integrating this force-deflection characteristic over the deformation of the field vehicle. The results of this model are compared with test data to indicate the types of damage patterns for which the model appears valid. Calculations are made for damage patterns resembling angle and offset barrier impacts, and the computed EBS is compared with the actual impact speed. For both types of test, the errors seem within normal test variability.

by K. L. Campbell  
General Motors Corp., Warren, Mich. Environmental Activities Staff  
Publ: HS-015 670(SAE-P-53). INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3rd) PROCEEDINGS, New York, 1974 p1-13  
Rept. No. SAE-740565 ; 1974 ; 2refs  
Availability: In HS-015 670



HS-015 672

# **AUTOMOTIVE RECORDER RESEARCH--A SUMMARY OF ACCIDENT DATA AND TEST RESULTS**

Automotive recorders which can measure crash trixial acceleration/time histories during vehicle collisions have been developed. From these acceleration histories (recorded on a magnetic disc), velocity/time histories and velocity change during impact are derived to provide measures of vehicle crash severity. These recorders were developed to provide accurate and quantitative relationships of vehicle crash severity with occupant fatalities and serious injuries from real-world accidents. To date, 1200 disc recorders have been produced, approximately 1050 recorders have been installed in fleet vehicles, and 23 accident records have been analyzed. Progress made in the Disc Recorder Pilot Project as of March 31, 1974 is reported. Recorder data from accidents involving vehicles equipped with disc recorders are discussed and compared with associated reports by accident investigators. Crash tests to which the disc recorders have been subjected are also described along with an evaluation of the results. Because of the recorder accuracy, confirmed by these tests under different speeds and conditions, it is concluded that the disc recorders are valid instruments for measuring vehicle crash severity.

by S. S. Teel; S. J. Peirce; N. W. Lutkefedder  
National Hwy. Traf. Safety Administration, Washington, D. C.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p14-70  
Rept. No. SAE-740566 ; 1974 ; 16refs  
Availability: In HS-015 670

HS-015 673

# **AN INEXPENSIVE AUTOMOBILE CRASH RECORDER**

The statistical basis for deployment of a data retrieval system is considered. A basis is provided for estimates of the amount of data required, the number of vehicles to be instrumented, the crash severity trigger levels, and the economics of recorder installations for various levels of injury and fatality. Results are presented in graph of time required to achieve N data points vs. time value of expected data, as applied to current U. S. statistical information. A brief outline of one feasible system for crash data recording and retrieval is included.

by C. Y. Warner; J. C. Free; B. Wilcox; D. Friedman  
Brigham Young Univ., Provo, Utah; Minicars, Inc.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p71-9  
Rept. No. SAE-740567 ; 1974 ; 18refs  
Availability: In HS-015 670

HS-015 674

# **FIRST RESULTS OF EXACT ACCIDENT DATA ACQUISITION ON SCENE**

Results of one year of work by a multidisciplinary team (physicians, engineers, and a psychologist) analyzing accidents in Hannover, Germany, are reported. The accident causes, course of events, and consequences should be examined by as

precise and accurate methods of data acquisition as possible at the scene of the accident. First results show that only 36% of the accidents could have been avoided or their consequences at least reduced. The remaining 64% were based on human error which can be avoided only with great difficulty, if at all. The main accident causes given were: excessive demand by unsuitable amount of information; excessive demand by too high information speed; detail overdemand (driving errors, inexperience, and ignorance of traffic rules); too high activity/activation (haste); external distraction; internal distraction; and realization (not in time) of security-relevant information or knowledge. The analysis of accidents involving pedestrians showed that the more serious injuries were due to the impact with the vehicle and not the road surface. To avoid pedestrian injury, the exterior design of the vehicle must be changed from rigid parts and sharp edges to well-rounded, deformable, energy-absorbing forms. Accident investigation equipment, accident sites, and injuries are photographed, and an accident diagram is included.

by U. N. Wanderer; H. M. Weber  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p80-94  
Rept. No. SAE-740568 ; 1974 ; 9refs  
Availability: In HS-015 670

HS-015 675

# **IN-DEPTH ACCIDENT DATA AND OCCUPANT PROTECTION--A STATISTICAL POINT OF VIEW**

In view of the inadequacy of the current federal accident data collection system, a proposed federal data collection system (SIR) is described which can solve, at a total cost of about \$6 million per year, problems related to answering cause-and-effect questions about accidents, injuries and fatalities, and to producing data for conducting cost benefit analyses of changes in vehicle designs, highway designs, or driver licensing policies. The SIR system would include 30 investigating teams precisely located through the U. S., and would include a Sampling program, an In-depth program, and a Rapid-response program. Immediate establishment of such a system is advocated.

by J. O'Day  
Michigan Univ., Ann Arbor. Hwy. Safety Res. Inst.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p95-102  
Rept. No. SAE-740569 ; 1974  
Availability: In HS-015 670

HS-015 676

# **DEVELOPMENT OF ENERGY ABSORBING AUTOMOTIVE STRUCTURES USING SCALE MODEL TEST TECHNIQUES**

To reduce the cost of developing energy absorbing structures for passenger cars and trucks, scale model test methods have developed. The scaling relationships needed to relate scale models to full size structures have been formulated and a test program conducted to validate the relationships and develop scaling factors. A 30-ft drop tower facility was constructed to conduct the test program. The tower allows impact velocities as high as 30 mph to be achieved and provides the necessary

instrumentation to obtain the crushing loads and crushing mode of the scale model specimens. The scale model test techniques and the drop tower were used to develop an energy absorbing frame for a light van type vehicle. Scale models were fabricated representing a number of possible design configurations. The models were tested and the design which best satisfied the design goals was further developed and tested. A brief description of an upgraded drop tower facility is also presented.

by M. J. Pavlick  
Budd Co.

Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION, (3RD)  
PROCEEDINGS, New York, 1974 p103-11  
Rept. No. SAE-740570 ; 1974  
Availability: In HS-015 670

HS-015 677

### FRONT END STRUCTURES CRASH RESPONSE CHARACTERIZATION

Results are summarized of a research program to develop and improve methods for characterizing automobile front end structures. Computer simulations of each structure and crash environment were conducted using an existing computer simulation program. Two front end structures, a ramped fixed-force system and a variable stroke velocity-sensitive system were incorporated into bogey vehicles which were crash-tested into a rigid barrier, a variable rigidity barrier, each other, and production vehicle front structures. These test results provided data by which computer simulation of the crash conditions were verified, providing a high degree of confidence in analytical representation of the structural crash responses. The empirical data were extended to other crash environments using the computer simulation techniques.

by L. M. Shaw; G. F. Brammeier; R. L. Anderson  
Ultrasystems, Inc., Phoenix, Ariz. Dynamic Science Div.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p112-22  
Rept. No. SAE-740571 ; 1974 ; 3refs  
Sponsored by the National Hwy. Traf. Safety Administration.  
Availability: In HS-015 670

HS-015 678

### CRASH ENERGY MANAGEMENT IN SUBCOMPACT AUTOMOBILES

Research programs to improve structural crashworthiness of subcompact cars are described. In two separate but related investigations, front structural designs intended to improve crash energy management were developed and adapted to a Datsun 510 and Chevrolet Vega. The prototype structure developed for the Datsun 510 was nominally consistent with present production manufacturing techniques and did not interfere with normal packaging requirements. This prototype design was evaluated through a series of 50 mph flat barrier tests. Excellent passenger compartment integrity and crash energy management was demonstrated for this prototype. The structural system developed for the Chevrolet Vega was similar in concept but manufacturing requirements were relaxed. The design was tested in a series of 60 mph frontal pole barrier impacts and 80 mph closing speed vehicular collisions with a production standard size automobile. The results indicated

substantial improvement over performance obtained from identical tests with conventional automobiles. The problem of providing crash energy management in small cars is contrasted with that of standard-size cars. The trade-off becomes one of smaller dimensional changes resulting in substantial changes in vehicular weight and kinetic energy. Results demonstrate that crash energy is more easily managed in the subcompact class automobile.

by P. M. Miller; M. O. Ryder, Jr.; N. E. Shoemaker  
Calspan Corp.

Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p123-30  
Rept. No. SAE-740572 ; 1974 ; 7refs  
Prepared in cooperation with the Nissan Motor Co., Ltd. and  
the National Hwy. Traf. Safety Administration.  
Availability: In HS-015 670

HS-015 679

### THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE CRASHWORTHINESS OF SMALL CARS

The philosophy, development, and optimization of two Volkswagen experimental safety vehicles are presented: the ESVW 1 and the ESVW 2. The collision safety criteria, vehicle data, overall concept, crash structure, and occupant restraint system of the ESVW 1 are detailed. The ESVW 2 fulfills requirements for active and passive safety far in excess of those for present day production vehicles. A frontal barrier crash test at 40 mph was used to demonstrate its deformation characteristics. The restraint system used for the front seat occupants was a two-point belt with knee bar, automatic retractor, force limiters and preloader. For the rear seat occupants, three-point belts with automatic retractors, force limiters and preloaders were used. Theoretical considerations of structural components were worked out with the aid of the finite element method supplemented by static pressure tests. The design was confirmed in a dynamic test with three occupants and measuring instruments (1100 kp). At a measured mean passenger cell deceleration of 24 g, the values for the head injury criterion and severity index for the chest were considerably below the tolerable value of 1000 and the femur loads were below the tolerable value of 771 kp. At its present stage of development, the ESVW 2 is about 15% heavier than the production model from which it was developed, and would cost about 30% more. The higher weight would increase fuel consumption by about 15%. These factors would appear unacceptable from a cost/benefit point of view. However, with the ESVW 2, Volkswagenwerk has endeavored to show what possibilities exist for the fulfillment of extreme safety requirements with small cars.

by H. J. Schimkat  
Volkswagenwerk A. G., Wolfsburg (West Germany)  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p131-40  
Rept. No. SAE-740573 ; 1974 ; 2refs  
Availability: In HS-015 670

HS-015 680

**BARBI, A NEW RADAR CONCEPT FOR PRECOLLISION SENSING**

A novel and low-cost scheme for automotive precollision sensing called BARBI (BASEband Radar Bag Initiator) is described. An extension of this technique is also suggested for braking applications. The proposed technique involves the transmission and reception of a subnanosecond baseband or video impulse-like signal (i.e., no RF carrier) and requires virtually no microwave components. The very fast signal risetime permits leading edge resolution on approaching vehicles of much less than a foot; closing velocity is obtained by using range-rate techniques. By incorporating sequential range gating techniques, the false alarm rate can be reduced to less than one in ten years for all the cars in the U. S. today.

by G. F. Ross

Sperry Rand Corp., Philadelphia, Pa.

Publ: HS-015 670 (SAE-P-53), INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, New York, 1974 p141-52

Rept. No. SAE-740574 ; 1974 ; 17refs

Availability: In HS-015 670

HS-015 681

**FLUID CRASH SENSOR**

A new crash sensor, using the electromagnetic effect of flowing electric conductive liquid, is described. This sensor consists of mercury as electric-conductive liquid, permanent magnet, Y-shape liquid passage, electrodes detecting liquid velocity, multihollow fibers as a G-level setting method, non-return ball valve, electronic voltage amplifier, comparator, and thyristor switches. This sensor shows short-time crash discrimination and high reliability.

by S. Ikeda; K. Nonaka; M. Fukushima

Asahi Chemical Industry Co. Ltd.

Publ: HS-015 670 (SAE-P-53), INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, New York, 1974 p153-67

Rept. No. SAE-740575 ; 1974 ; 5refs

Availability: In HS-015 670

HS-015 682

**THE DEVELOPMENT OF AN AIR BAG ON COLLAPSIBLE DASH PANEL RESTRAINT SYSTEM FOR RIGHT FRONT SEAT OCCUPANTS**

An air bag on collapsible dashpanel (ABCD) is described which is positioned within steering wheel distance or greater of the occupant to absorb the primary portion of the kinetic energy of the occupant-vehicle interaction, and which uses two small air bags to deploy at speeds above 20 mph to distribute chest contact forces and control head motions. A crushable kneebar is used for lower torso restraint. The Calspan 3-D Crash Victim Simulation was used as a preliminary design tool in developing the concept. Component tests of the collapsible dashpanel were conducted on the Calspan linear accelerator impactor. Sled tests were conducted to refine the restraint system design and to evaluate the performance of the restraint system with respect to accepted injury criteria. Satisfactory restraint system performance was demonstrated for the 50-lb child at 40 mph and the 50th percentile male at 50

mph. Performance for the 95th percentile male at 45 mph was marginal. The ABCD concept was demonstrated to be a feasible passive restraint system which shows promise for improving occupant protection.

by N. E. Shoemaker; D. J. Biss

Calspan Corp.

Publ: HS-015 670 (SAE-P-53), INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, New York, 1974 p168-88

Rept. No. SAE-740576 ; 1974 ; 12refs

Availability: In HS-015 670

HS-015 683

**STUDY ON AIR BAG SYSTEMS FOR NISSAN SMALL-SIZED CARS**

The most important characteristics of the practical type air bag being developed by Nissan Motor Co. are outlined. Results are explained of various occupant protection tests conducted at 10 to 40 mph speeds, and the related problems encountered. Effects are discussed of several types of occupant protection systems installed on small-sized cars and the relationships between those effects and limited crash speeds. An examination and analysis of air bag performance test results is also included. Problems still to be solved include: high-speed collisions make it difficult to reduce femur load by means of air bag systems alone; passengers such as three-year-old children and 5th percentile female adults display a tendency toward submarining; when the environmental temperature is very low, it is difficult for the air bag to meet the FMVSS occupant protection requirements.

by F. Abe; S. Satoh

Nissan Motor Co. Ltd., Yokohama (Japan)

Publ: HS-015 670 (SAE-P-53), INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, New York, 1974 p189-211

Rept. No. SAE-740577 ; 1974

Availability: In HS-015 670

HS-015 684

**HUMAN VOLUNTEER AND ANTHROPOMORPHIC DUMMY TESTS OF GENERAL MOTORS DRIVER AIR CUSHION SYSTEM**

Forty dynamic tests of the General Motors driver air cushion system using human volunteers were conducted at eight different impact severities. Thirty-two anthropomorphic dummy tests were made under similar conditions. The test work proceeded as planned through impacts equivalent to a 30 mph barrier crash of a full size vehicle. No significant injuries were experienced by the volunteers. The extent of trauma was generally limited to minor abrasions, ecchymosis, and erythema. In comparable tests, the anthropomorphic dummies'

May 31, 1975

HS-015 690

response to impact was more exaggerated than that of the humans.

by G. R. Smith; E. C. Gulash; R. G. Baker  
General Motors Corp., Warren, Mich. Environmental Activities Staff  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, New York, 1974 p212-26  
Rept. No. SAE-740578 ; 1974  
Prepared in cooperation with Southwest Res. Inst., San Antonio, Texas for the National Hwy. Traf. Safety Administration.  
Availability: In HS-015 670

HS-015 686

### **THE EFFORTS OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION IN THE DEVELOPMENT OF ADVANCED PASSIVE PROTECTION SYSTEMS AND CHILD RESTRAINT SYSTEMS**

An overview is presented of the Occupant Packaging research program of NHTSA with focus on the program's efforts to establish the feasibilities of practical methods for providing the highest levels of occupant protection. In the area of frontal impact protection, work is progressing on advanced driver air bag systems, on a bag and bolster approach to passenger protection, on the development of improved inflation techniques for inflatables, and on the passive application of the air belt concept. Efforts in other areas of side, rear, and rollover protection are discussed as are NHTSA's efforts in child restraint research.

by C. E. Strother; R. M. Morgan  
National Hwy. Traf. Safety Administration, Washington, D. C.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, New York, 1974 p246-67  
Rept. No. SAE-740580 ; 1974 ; 15refs  
Availability: In HS-015 670

HS-015 687

### **DEVELOPMENT OF ENERGY-ABSORBING SAFETY BELT WEBBING**

Tests of various seat belt systems are described which compared rheological properties of conventional webbings and Takata Kojyo Co.'s newly developed webbing. The quantity of absorbed impact energy and the rate of absorbing energy were obtained and compared through tests at various impact speeds. Dummy tests conducted to compare the improved Takata energy absorbing webbing with conventional webbing showed the conspicuous superiority of the Takata webbing. Using the improved webbing, two live human volunteers were able to successfully complete tests at impact speeds of 30.3 and 30.4 mph without injury or pain. It is suggested that future tests should utilize human volunteers rather than anthropomorphic dummies.

by J. Takada  
Takata Kojyo Co. Ltd. (Japan)  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, New York, 1974 p268-73  
Rept. No. SAE-740581 ; 1974 ; 1ref  
Availability: In HS-015 670

HS-015 688

### **A FORCE LIMITING SYSTEM ON A THREE-POINT-BELT SYSTEM DEPENDING ON CRASH VELOCITY**

This force limiter produces a belt force such that, at the maximum requested crash velocity and each lower one, the maximum possible relative forward displacement between passenger and vehicle will be almost used. The passenger loads from the belt will be reduced, as well as the decelerations affecting the passenger, at a lower level than the maximum requested crash velocities in accident studies, and injuries by the belt will be effectively reduced. The principle of the force limiter is a hydraulic throttling member. Descriptions are given of the mathematical analog-digital simulation of a simplified passenger-vehicle model, and of construction of a test unit of a force limiter to approximate the theoretical findings.

by D. Adomeit  
Institute of Automotive Engineering, Berlin Technical Univ.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, New York, 1974 p274-82  
Rept. No. SAE-740582 ; 1974 ; 2refs  
Availability: In HS-015 670

HS-015 689

### **PERFORMANCE MATRICES OF FOUR RESTRAINT SYSTEMS**

For three given deceleration pulses of defined shape and peak magnitude, total velocity change was varied from 20 to 40 mph by changing duration of the pulse. Several restraint systems were compared, for these combinations of speed change and pulse shape, using head injury criterion, chest severity index, and femur loads to evaluate potential injury. Limit curves for each restraint are developed in terms of velocity change and peak deceleration, and the significance of these curves is discussed.

by U. Seiffert; W. Schwanz  
Volkswagenwerk A. G., Wolfsburg (West Germany)  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, New York, 1974 p283-97  
Rept. No. SAE-740583 ; 1974 ; 3refs  
Availability: In HS-015 670

HS-015 690

### **IMPROVED RESTRAINT FOR U. S. ARMY AIRCREWMEN**

Modern restraint system technology was surveyed and a proposed military specification defining a forward-facing restraint system for use in Army aircraft was formulated. The materials, design concepts, and features found desirable for maximizing protection were included in the specification. Consideration was given to lap belt retractor, double inertia reel, single-point release buckle, adjusters, and webbing of sufficiently low elongation. The completed effort resulted in a thorough evaluation of the technology and a revision of the military specification to reflect the state of the art in restraint

HS-015 691

systems. Verification that the requirements of the proposed military specification can be met were demonstrated.

by R. W. Carr; W. J. Nolan  
Ultrasystems, Inc., Phoenix, Ariz.; Army Air Mobility Res.  
and Devel. Lab.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p298-313  
Rept. No. SAE-740584 ; 1974  
Availability: In HS-015 670

HS-015 691

#### **AN INTRODUCTION TO SCALE MODEL TESTING TO DETERMINE AIR CUSHION CRASH SENSOR LOCATION**

Design validation of crash sensors in the vehicle barrier impact environment is shown to be difficult and costly, and a method is outlined for developing optimum crash sensor mounting utilizing reduced-scale physical models. This technique incorporates design tools that are readily accessible during early vehicle concept stages which will allow mechanical impedance checks of the crash sensor to vehicle structure interface at significantly lower cost than full size prototype testing. Basic equations and methodology are presented with experimental correlation data.

by T. O. Jones; W. A. Elliott  
General Motors Corp. Engineering Staff, Warren, Mich.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p314-22  
Rept. No. SAE-740585 ; 1974 ; 6refs  
Availability: In HS-015 670

HS-015 692

#### **SCALE MODELING OF VEHICLE CRASHES-- TECHNIQUES, APPLICABILITY, AND ACCURACY; COST EFFECTIVENESS**

The utility of scale model experiments for crashworthiness research is examined. In Part 1, two examples illustrate the use of scale models in crashworthiness research. The accuracy of modeling is shown by direct comparison between a model experiment and the test of a complete automobile in high-speed impact. It is concluded that scale models can be used in place of full-scale experiments for many applications. The comparison of hydraulic and plastic deformation energy absorbers in scale model experiments demonstrates the ability of models to reproduce the response of a wide variety of vehicle elements. In Part 2, the cost effectiveness of scale modeling is measured by comparing the costs of full-scale experiments with scaled experiments that meet the same objectives. The comparisons include both individual tests of various types and complete vehicle development programs. It is concluded that scaled experiments increase the flexibility, reduce the cost, and hasten the completion of a program.

by B. S. Holmes; G. Sliter  
Stanford Res. Inst. Poulter Lab.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p323-48  
Rept. No. SAE-740586 ; 1974 ; 10refs  
Sponsored by the Dept. of Transportation.  
Availability: In HS-015 670

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HS-015 693

#### **TEST SLED SIMULATION OF CRASH INDUCED YAW AND PITCH**

The design concepts and development of a sled test compartment which exhibits yaw and pitch displacements as a function of the applied sled deceleration pulse are examined. The program is outlined in which the compartment was developed, and the qualitative differences are noted which were encountered when testing with these additional motions as opposed to testing with a fixed sled compartment.

by A. Jordan  
Minicars, Inc., Santa Barbara, Calif.  
Contract DOT-HS-113-2-441  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p349-56  
Rept. No. SAE-740587 ; 1974  
Availability: In HS-015 670

HS-015 694

#### **THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY**

Two Highway Safety Research Institute (HSRI) dummies were tested and evaluated. Based on the analysis given, the HSRI dummy should not be used for vehicle qualification testing, although many of its components offer viable alternatives for future dummy development. The dummy was found to have inadequate biomechanical fidelity in the head, neck, and chest, although its characteristics were very promising and generally biomechanically superior to the Hybrid 2. Its repeatability and reproducibility in dynamic component tests were better than the Hybrid 2 dummy. In particular, the HSRI friction joints were outstanding in repeatability and had a significant advantage in usability in that they do not require resetting between tests. In three-point harness and ACRS systems tests, the values of injury criteria produced by the HSRI dummy were generally lower than those obtained with the Hybrid 2, especially the femur loads in the ACRS tests. However, the repeatability and reproducibility of the HSRI dummy were significantly poorer than the Hybrid 2. Significant durability problems exist with the skin and lumbar spine of the HSRI dummy.

by R. F. Neathery; H. J. Mertz; R. P. Hubbard; M. R. Henderson  
General Motors Research Labs., Warren, Mich.; General  
Motors Corp., Warren, Mich. Environmental Activities Staff  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p357-75  
Rept. No. SAE-740588 ; 1974 ; 8refs  
Prepared in cooperation with the Hwy. Safety Res. Inst,  
Michigan Univ., Ann Arbor. Sponsored by the Motor Vehicle  
Mfrs. Association.  
Availability: In HS-015 670

HS-015 695

#### **DISCUSSION (THE HSRI DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY**

May 31, 1975

HS-015 699

## **RECOMMENDATIONS AND THE HYBRID 2 DUMMY)**

Findings reported in the General Motors paper concerning the Highway Safety Research Institute's anthropomorphic dummy's reliability in comparison with the GM Hybrid 2 dummy are examined. Where possible, the sources of variance between the test results are clarified. Specific consideration is given to evaluations of the head, neck, and chest as well as the systems tests and test repeatability and reproducibility.

by R. L. Hess; J. W. Melvin  
Michigan Univ., Ann Arbor. Hwy. Safety Res. Inst.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p376-83  
1974 ; 6refs  
Includes Authors' closure.  
Availability: In HS-015 670

HS-015 696

## **HUMAN CHEST IMPACT PROTECTION CRITERIA**

Unembalmed human cadavers were used to conduct nine frontal and 14 lateral impacts, including four with a simulated arm rest. All impacts used a six inch diameter impactor with impact velocities ranging from 12 to 20 mph. Chest impacts were also conducted on rhesus monkeys and baboons to establish primate-human injury scaling criteria. Four human volunteers were used to obtain static load deflection curves in the lateral and frontal directions. The results indicate that muscle force and breath holding in live humans tends to make their chests stiffer than those of unembalmed cadavers. Maximum forces ranged from 500 to 1400 lbs, maximum deflection from 1.9 to 3.2 in. and pulse duration from 10 to 47 milliseconds. Rib fractures were observed at the higher velocities around 29.3 fps. The results of dynamic as well as static tests indicated that maximum deflection and not maximum force is the determining factor for rib fractures. Both in the static and dynamic tests, rib fractures were more frequent at chest deflections of over 3 in., whereas none occurred at deflections less than 2.3 in. Chest impact protection criteria are suggested from the standpoints of both restraint system design and vehicle interior design for front and side collisions.

by R. L. Stalnaker; D. Mohan  
Michigan Univ., Ann Arbor. Hwy. Safety Res. Inst.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p384-93  
Rept. No. SAE-740589 ; 1974 ; 6refs  
Availability: In HS-015 670

HS-015 697

## **GM-ATD 502 ANTHROPOMORPHIC DUMMY-- DEVELOPMENT AND EVALUATION**

The development, manufacture and testing of a new anthropomorphic test dummy (GM-ATD 502) is discussed. Improvements in performance repeatability and reproducibility of the dummy are documented and the anthropometric and biomechanical basis of the design described. The development of repeatable testing procedures and dummy features that

enhance the accuracy of the initial test setup are also discussed.

by J. A. Tennant; R. H. Jensen; R. A. Potter  
General Motors Engineering Staff, Warren, Mich.  
Publ: HS-015 670 (SAE-P-53), INTERNATIONAL  
CONFERENCE ON OCCUPANT PROTECTION (3RD)  
PROCEEDINGS, New York, 1974 p394-420  
Rept. No. -SAE-740590 ; 1974 ; 11refs  
Sponsored by the National Hwy. Traf. Safety Administration.  
Availability: In HS-015 670

HS-015 698

## **A PROCEDURE FOR THE PHOTOMETRIC DETERMINATION OF HEADLAMP AIM BY ISOLUX CONTOUR MATCHING**

The intensity map for a headlamp and the illumination map on the vertical plane constructed from the isocandela data are discussed, and a procedure is outlined for determining the headlamp aim by means of these two maps. The measurement procedure for the isocandela data is described, with a discussion of the correction of certain errors present in the data. A brief note is made concerning the various computer programs which perform the mapping and plotting functions; these are discussed in greater detail in separate reports. The laboratory set-up of the test vehicle or cart and the screen on which the check map is displayed is described. The question of the headlamp aim is discussed in relation to the vertical mapping plane. The procedure for finding the headlamp aim is discussed, illustrated by the treatment of a sample headlamp.

by A. L. Harrison  
National Aeronautical Establishment, Ottawa, Ont. (Canada)  
Rept. No. LTR-ST.720 ; 1974 ; 52p 6refs  
Availability: Corporate author

HS-015 699

## **DRUG EFFECTS ON VISION: STRATEGIES FOR STUDY AND SELECTED RESULTS**

Some of the difficulties associated with the problem of determining drug effects on the visual sensory system are outlined. Specific consideration is given to the selection of human and animal subjects for study, the use of electrophysiological techniques, and a variety of experimental procedures which may be employed. Problems associated with the attention and motivation of subjects, the use of anesthesia, and the need for investigation of a wide range of drug dosages are discussed. Some experiments which reveal fairly specific effects on visual function are described.

by J. L. Brown  
Publ: HUMAN FACTORS v16 n4 p354-67 (Aug 1974)  
1974 ; 73refs  
Sponsored by the Office of Naval Res. and by the Public  
Health Service, National Eye Inst.  
Availability: See publication

HS-015 700

HSL 75-5

HS-015 700

### **COMMUTER DEMAND FOR BICYCLE TRANSPORTATION IN THE UNITED STATES**

The demand for bicycle transportation is analyzed. Some of the benefits given are: exercise, recreation and relaxation, convenience, and lower cost than automobile transportation. The major conclusion is that, in spite of the many social and private benefits of bicycling, the mere construction of a safe bike route in a congested urban area may not be enough to divert large numbers of persons from their cars or even to assure reasonable usage of the route. Experience with bicycle lanes in Washington, D. C. and Chicago and their usage is cited. It is shown that Bike routes must be planned and constructed as part of an overall transportation system so that the total cost of cycling (including time as well as vehicle costs) is less than that of driving for the majority of commuters, unless driving is severely restricted as a result of energy shortages or public policy.

by M. Everett

Publ: TRAFFIC QUARTERLY v28 n4 p585-601 (Oct 1974)

1974 ; 24refs

Availability: See publication

HS-015 701

### **BICYCLES, CARS AND ENERGY**

Total energy requirements for bicycling, including those to produce the additional food consumed by cyclists, to manufacture and sell bicycles and tires, to repair and maintain bicycles, and to construct bikeways, are estimated. These energy and dollar costs are then compared with similar data for urban automobile travel. The energy savings due to a switch from cars to bicycles is about 10,000 Btu per PM, almost a 90 % reduction. If 10% of the automobile travel conducted during daylight and in good weather for trips of five miles or less were shifted to bicycles, the savings in 1971 would have been about 180 trillion Btu, or 1.8% of the total urban automobile energy use, the equivalent of more than \$800 million. Additional potential benefits of cycling include reduced urban parking problems; reduced air and noise pollution; improved health for cyclists; greater mobility for cyclists; the possibility of combining recreation, exercise, and transportation in the same trips; and an increase in urban transportation options. Offsetting these benefits are the problems associated with personal safety, bicycle security, exposure of cyclists to automobile exhaust, exposure to inclement weather, inability to carry heavy loads on bicycles, and the need for reasonably good health to cycle.

by E. Hirst

Publ: TRAFFIC QUARTERLY v28 n4 p573-84 (Oct 1974)

1974 ; 11refs

Sponsored by the National Science Foundation RANN Program under a Union Carbide Corp. contract with the U. S. Atomic Energy Commission.

Availability: See publication

HS-015 702

### **INFLUENCES ON THE DRIVING BEHAVIOR OF AUTOMOBILES (EINFLOSSE AUF DAS FAHRVERHALTEN VON KRAFTFAHRZEUGEN)**

Influences on vehicle handling are examined in terms of stationary and nonstationary driving conditions. Measurements are taken from practical driving reports and a critical analysis of the results is included. Consideration is given to: self-steering behavior of modern European automobiles; maximum lateral acceleration as measured in the cornering test; vehicle stability when driving in a straight line; reactions to steering maneuvers; stability when changing the driving state in curves; front wheel suspension and the steering system; rear wheel guidance; steering arms; steering linkage; rear wheel suspension; and suggestions for more precise automobile tests. Forty-four tables are included.

by K. O. Langwieder

Technische Hochschule, Munich (West Germany)

Rept. No. TT-72-55007 ; 1972 ; 283p 52refs

Translation prepared for the National Science Foundation and the National Hwy. Traf. Safety Administration, Washington, D. C. Master's thesis, dtd. Apr. 1969. Original text in German.

Availability: NTIS

HS-015 703

### **THE IMPACT OF DRIVER IMPROVEMENT: DO WE REALLY WANT TO KNOW?**

Evaluative research in driver improvement is examined and found to be either naive with regard to the concepts of face validity, construct validity and regression effects, or to be skeptical. Rededication to valuable research methods is advocated, including consideration of administrative, criterial, statistical, and theoretical model problems. There is a continuing need to develop diagnostic devices in order to provide tailor made programs to the needs of individual problem drivers, and to develop a broader base of clientele so that incipient problem drivers are recipients of program attention earlier in their driving careers. More attention also should be paid to cost effectiveness and cost benefit analysis of programs that do have significant impacts on traffic collisions. It is important that these analyses not be restricted to departmental savings at the operational level, but that they also incorporate savings to the drivers in the state from accidents that did not occur.

by N. F. Kaestner

1974 ; 37p 32refs

Presented at the 10th meeting of the North Carolina Symposium on Hwy. Safety, Raleigh, Mar 1974.

Availability: University of North Carolina, Chapel Hill, Highway Safety Research Center

HS-015 704

### **THE USE OF HUMAN SUBJECTS IN HUMAN FACTORS RESEARCH**

Some legal and ethical aspects of utilizing human subjects in research are discussed. Among these key issues are: How does one make a fair judgment of the risks involved as opposed to the potential benefits to be gained? Can one be assured of a subject's informed consent? How can a researcher protect himself against liabilities arising from accusations of negligent



behavior? As part of the answer, it is suggested that the Human Factors Society establish committees to recommend a code of ethics for its members and also review proposals for human research at the request of its members. Such provisions could be of legal and ethical value in the protection of its member researchers and would help establish and preserve a high professional recognition for the society's leadership in human factors research involving risk to the human subject.

by J. M. Miller; T. H. Rockwell  
 Publ: HUMAN FACTORS v14 n1 p35-40 (Feb 1972)  
 1972 ; 12refs  
 Availability: See publication

HS-015 705

### **INTERRUPTED TIME-SERIES METHODS FOR THE EVALUATION OF TRAFFIC LAW REFORMS**

Interrupted time-series methods are examined and found to be well suited for evaluating legal changes. As a quasi-experimental technique, it does not require random assignment of individuals or groups to different legal treatments, and it avoids the related ethical and practical problems which frequently interfere with attempts at experimentation in the law. In comparison to the inferior before-and-after study, the interrupted time series is far more interpretable, and its data requirements are often met with easily available public data. In the area of traffic law, fatal accidents are well measured, with long series for a variety of jurisdictions. Other types of accident are more frequent and provide bigger data bases, but may have considerably less validity. In areas of law other than traffic, routine series of statistics are also commonly available, although their validity may be problematic in some cases. Suggestions are offered to increase the chances for successfully applying the model to the study of projected reforms. The usefulness of interrupted time-series analysis in the study of legal policies is emphasized, where its requirements are often easy to satisfy and where adequate research models are often inapplicable. Its applicability to the study of traffic law, and particularly the study of laws relating to drinking and driving, is enhanced by the relatively clear goals for legislation in this area.

by H. L. Ross  
 Denver Univ.  
 1974 ; 24p 18refs  
 Presented at the 10th meeting of the North Carolina Symposium on Hwy. Safety, Raleigh, Mar 1974.  
 Availability: North Carolina Univ., Chapel Hill. Hwy. Safety Res. Center

HS-015 706

### **INTERNATIONAL CONFERENCE ON VEHICLE STRUCTURAL MECHANICS: FINITE ELEMENT APPLICATION TO VEHICLE DESIGN, PROCEEDINGS, DETROIT, MICHIGAN, MARCH 26-28, 1974**

Papers presented are generally divided into seven subject areas: recent advances in finite element methods; static analysis; fatigue analysis; dynamic analysis and crash; nonlinear

analysis; modeling techniques; and computer aided pre- and post-processing.

Society of Automotive Engineers, Inc.  
 Rept. No. SAE-P-52 ; 1974 ; 290p refs  
 Includes HS-015 707--HS-015 734. Sponsored by the Computer Applications Committee of SAE Passenger Car Activity.  
 Availability: SAE

HS-015 707

### **SURVEY OF SOLUTION PROCEDURES FOR NONLINEAR STATIC AND DYNAMIC ANALYSES**

The solution techniques most widely used for solving the governing equations for static and dynamic, large deflection, elastic-plastic response of structures are reviewed. For the transient response, one explicit direct integration method (central differences) and three implicit methods (Houbolt, Newmark Beta, and Wilson) are compared with respect to accuracy and stability. A modal superposition technique is developed and compared to the direct integration methods. It is concluded that the choice of a suitable method depends on the structure and loading involved and on the frequency response desired. For the static response, the available techniques are grouped according to whether they yield exact or approximate solutions to the nonlinear equations. The convergence characteristics for each method are summarized. Although it is concluded that the choice of methods depends on which type of nonlinearity (geometric or material) is most significant, the first-order self-correcting method is recommended as the best method overall for static problems.

by J. A. Stricklin; W. E. Haisler  
 Texas A and M Univ., College Station. Aerospace Engineering Dept.  
 Contract N00011-68-A-0308-0004 Grant NSF-35914  
 Publ: HS-015 706 (SAE-P-52), INTERNATIONAL CONFERENCE ON VEHICLE STRUCTURAL MECHANICS PROCEEDINGS, New York, 1974 p1-17  
 Rept. No. SAE-740317 ; 1974 ; 64refs  
 Availability: In HS-015 706

HS-015 708

### **ELASTIC-PLASTIC PLATE BENDING WITH CONSTANT CURVATURE ELEMENTS**

A consistent curvature triangular plate bending element is developed for the elastic-plastic bending of laterally loaded plates. First, a constant curvature element is developed which eliminates the mid-side degrees of freedom found in elements of previous investigations. The convergence of this modified constant curvature element to elastic theoretical results then is demonstrated for several plates. Finally, this element is used to predict the elastic-plastic behavior of these plates. Good agreement is indicated with the collapse load for ideally plastic plates.

by L. A. Larkin  
 A. O. Smith Corp., Milwaukee, Wis.  
 Publ: HS-015 706 (SAE-P-52), INTERNATIONAL CONFERENCE ON VEHICLE STRUCTURAL MECHANICS; PROCEEDINGS, New York, 1974 p18-25  
 Rept. No. SAE-740318 ; 1974 ; 10refs  
 Availability: In HS-015 706



HS-015 709

**FINITE ELEMENT ANALYSIS OF AUTOMOBILE STRUCTURES**

The success of efforts to predict linear static, dynamic, and nonlinear transient behavior of car components and structural systems is reviewed. The analysis accuracy is related to essential features of car structure. It is shown how these features, the existing level of quality control of structural characteristics during fabrication and assembly and the complexity of geometry, conspire to make accurate simulation using current practices unnecessarily costly, in dollars and time. Work currently being done to justify broader use of numerical methods in the automobile industry is reviewed as well.

by R. J. Melosh

Virginia Polytechnic Inst. and State Univ.

Publ: HS-015 706 (SAE-P-52), INTERNATIONAL

CONFERENCE ON VEHICLE STRUCTURAL

MECHANICS PROCEEDINGS, New York, 1974 p26-38

Rept. No. SAE-740319 ; 1974 ; 23refs

Availability: In HS-015 706

HS-015 710

**FINITE ELEMENT STRUCTURAL ANALYSIS AS APPLIED TO AN AUTOMOTIVE DOOR STRUCTURE**

The effectiveness of finite element structural analysis in providing meaningful structural design predictions within the allotted design cycle and in providing better designs at reduced costs was examined. Application was made to a door structure. Various techniques were developed covering analytical modeling of complex structures and automated input data generation and output data interpretation using the graphic system. The results of the study show finite element structural analysis, when used with an interactive graphic system, can be used successfully as a powerful design tool for automobile body components.

by S. W. Park; F. W. DuVall

Ford Motor Co, Dearborn, Mich. Body Engineering Office

Publ: HS-015 706 (SAE-P-52), INTERNATIONAL

CONFERENCE ON VEHICLE STRUCTURAL

MECHANICS PROCEEDINGS, New York, 1974 p39-57

Rept. No. SAE-740320 ; 1974 ; 4refs

Availability: In HS-015 706

HS-015 711

**AN AXISYMMETRIC FINITE ELEMENT ANALYSIS OF THE MECHANICAL AND THERMAL STRESSES IN brake drums**

A linear elastic finite element analysis of brake drums is presented. The axisymmetry is assumed for the geometry of the structure; but the loads may be arbitrary. Laboratory measurements of the mechanical stresses support the computational analysis. The economy and predictability of the analysis warrant its usage as a design procedure for brake drums and other axisymmetric bodies. If a particular structure has a regular generic form, mesh generators which accept body parame-

ters may be developed to increase the turn-around time of analysis.

by P. A. Fensel

Dayton-Walther Corp.

Publ: HS-015 706 (SAE-P-52), INTERNATIONAL

CONFERENCE ON VEHICLE STRUCTURAL

MECHANICS PROCEEDINGS, New York, 1974 p58-66

Rept. No. SAE-740321 ; 1974 ; 7refs

Availability: In HS-015 706

HS-015 712

**APPLICATION OF FINITE ELEMENT METHODS TO COMPLETE AUTOMOBILE STRUCTURAL DESIGN EVALUATION**

The need for minimum complexity models of complete body/chassis structures is discussed. Calculations of deflections, loads, and stresses resulting from load applications to this type of model are presented. Comparisons with similar though not exact actual vehicle test results are presented. Evaluation of the computer model is made and future improvements for the model and modeling techniques are discussed.

by K. H. Wadleigh

Chrysler Corp.

Publ: HS-015 706 (SAE-P-52), INTERNATIONAL

CONFERENCE ON VEHICLE STRUCTURAL

MECHANICS PROCEEDINGS, New York, 1974 p67-72

Rept. No. SAE-740322 ; 1974

Availability: In HS-015 706

HS-015 713

**STATIC ANALYSIS VIA SUBSTRUCTURING OF AN EXPERIMENTAL VEHICLE FRONT-END BODY STRUCTURE**

A static analysis of the front-end structure of an experimental vehicle which identified the high stress areas is presented. NASA Structural Analysis (NASTRAN), a finite element computer program, was used for the analysis. The size of the mathematical model was large (17,000 degrees of freedom) and substructuring techniques were utilized. Procedures pertinent to NASTRAN substructuring are described, and the theoretical relationships are summarized. Interpretation of results, comparison between analytical and experimental results, as well as computer cost and manpower requirements, are also discussed.

by L. I. Nagy

Ford Motor Co., Dearborn, Mich.

Publ: HS-015 706 (SAE-P-52), INTERNATIONAL

CONFERENCE ON VEHICLE STRUCTURAL

MECHANICS PROCEEDINGS New York, 1974 p73-80

Rept. No. SAE-740323 ; 1974 ; 17refs

Availability: In HS-015 706

HS-015 714

# **THE USE OF ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS IN THE CALCULATION OF CUMULATIVE FATIGUE DAMAGE**

A NASTRAN elastic-plastic finite element analysis of a notched fatigue specimen was performed and the results compared with experimental notch root strain. The calculated notch stress and strain were used in a cumulative damage procedure for determining specimen life which was compared to experimental fatigue life for three different loading spectrums for a Man-Ten steel material. The finite element analysis shows promise in replacing the full scale testing of prototypes now required to determine notch factors. Fatigue prediction from the drawing board could allow redesign of critical areas before expensive prototypes are built.

by G. E. Barron  
A. O. Smith Corp., Milwaukee, Wis.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p81- 8  
Rept. No. SAE-740324 ; 1974 ; 11refs  
Availability: In HS-015 706

HS-015 715

# **THE COMPUTATION OF TEARING ENERGY OF NICKED RUBBER STRIPS IN EXTENSION**

With the aid of the finite element method (FEM), it is shown that solution of the stress-deformation involving finite elasticity which is associated with the tearing energy of nicked rubber strips in extension, can be done simply through the use of the Rice's J integral. Tearing energy for two testpieces are computed and results compared with existing experimental data. The agreement is good. Because of FEM's ability to treat general geometric and loading conditions, the use of the J integral in combination with FEM to compute the tearing energy now allows a wider application of the tearing energy concept to more complex units than hitherto known.

by H. L. Oh; N. -M. Wang  
General Motors Research Labs., Warren, Mich.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p89-94  
Rept. No. SAE-740325 ; 1974 ; 9 refs  
Availability: In HS-015 706

HS-015 716

# **NASTRAN FOR DYNAMIC ANALYSIS OF VEHICLE SYSTEMS**

An approach to the dynamic analysis of vehicle systems is described which takes advantage of pre-processor programs, NASTRAN, post-processor programs and computer interfaced testing equipment to perform an efficient vehicle dynamic analysis. The technique uses a building block approach to the analysis of the vehicle system which allows for the overall analysis to be determined from the dynamic performance of various subsystems. The dynamic characteristics of the

subsystems are determined by various computer codes and experimental investigations.

by W. A. McClelland; A. L. Klosterman  
Structural Dynamics Res. Corp., Cincinnati, Ohio  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p95-107  
Rept. No. SAE-740326 ; 1974 ; 9refs  
Availability: In HS-015 706

HS-015 717

# **AN INTERACTIVE HYBRID TECHNIQUE FOR CRASHWORTHY DESIGN OF COMPLEX VEHICULAR STRUCTURAL SYSTEMS**

An interactive hybrid technique has been investigated as a feasible method for allowing the designer a means to predict failure modes and general crashworthiness response of complex multi-degree of freedom structural systems, such as the automotive vehicle, without the necessity of innumerable, costly destructive tests. The technique employs average internal energy of deformable elements and internal reaction of load density spectrums, with a simplified yield and buckling criterion, as the mechanism for predicting collapse modes of the shock excited system containing large arbitrary shaped rigid bodies which are linked by structural elements, composed of nonlinear, rate-sensitive, materials. Incremental finite element approximations account for system nonlinearities in critical regions, identified by the predicted collapse mode, so as to allow judicious modeling of the system. By predicting where and in what manner failure is most likely to occur, the technique provides a simplified analytical type tool to aid in the crashworthy design of a broad class of shock excited structural configurations with general constraints. An outline of the technique, along with results of preliminary investigations are given. Relationships to the present state of knowledge in the field regarding analytical techniques for crashworthy design are discussed.

by K. J. Saczalski; K. C. Park  
Office of Naval Research, Washington, D. C.; Lockheed-California Co., Burbank  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p108-23  
Rept. No. SAE-740327 ; 1974 ; 40refs  
Availability: In HS-015 706

HS-015 718

# **POWER SPECTRAL DENSITY ANALYSIS OF VEHICLE VIBRATION USING THE NASTRAN COMPUTER PROGRAM**

Frequency response and power spectral density analyses are implemented on the NASTRAN computer program for the purpose of assessing the vibratory response of automotive vehicles. A review of theoretical concepts related to the frequency domain techniques is presented, followed by a derivation of the equations of vertical motion for a linearly elastic automotive vehicle. Special emphasis is given to the discussion of random loading, and the cross-spectral density matrix for the terrain input to a four-wheel vehicle is derived.

Example calculations are performed for a compact sized car exposed to moderately severe road roughness.

by L. J. Howell

General Motors Research Labs., Warren, Mich.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p124-33  
Rept. No. SAE-740328 ; 1974 ; 17refs  
Availability: In HS-015 706

HS-015 719

### A MODAL SYNTHESIS TECHNIQUE FOR DETERMINING DYNAMIC PROPERTIES FOR A STRUCTURE FOR MASS AND STIFFNESS CHANGES

The assembly and particularly the reduction of the mass and stiffness matrix for a large system can be a significant portion of the computational cost of finding the mode shapes and natural frequencies; parameter studies for design purposes can be prohibitive if these matrices are reassembled and reduced for each change. The procedure is outlined for using the modes of the original system to determine the dynamic characteristics of the changed system. The method also results in computational savings for boundary condition changes and for large systems that are nearly symmetric except for a few mass and stiffness changes. To illustrate the method, several changes are made to a ladder frame. The results from an analysis using the reconstructed mass and stiffness matrices and the modal synthesis technique are compared to show the accuracy and freedom requirements.

by C. F. Vail

General Motors Research Labs., Warren, Mich.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p134-44  
Rept. No. SAE-740329 ; 1974 ; 6refs  
Availability: In HS-015 706

HS-015 720

### THE USE OF CONDENSATION TECHNIQUES FOR SOLVING DYNAMICS PROBLEMS

The theory behind condensation techniques is explained and their use is illustrated along with the theory underlying condensation. The numerical techniques for efficiently generating the condensed equations are outlined. Three examples of condensation are given to show the approximation involved and the error that can be expected.

by M. F. Nelson

General Motors Research Labs., Warren, Mich.;  
Massachusetts Inst. of Tech.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p145-53  
Rept. No. SAE-740330 ; 1974 ; 12refs  
Sponsored by the Stone and Webster Engineering Corp.,  
Boston, Mass  
Availability: In HS-015 706

HS-015 721

### A USER-ORIENTED PROGRAM FOR CRASH DYNAMICS

The conversion of a crash analysis program is described from its original batch program form with awkward input to an efficient, user-oriented interactive tool. The program simulates a vehicle occupant with a two dimensional, seven link mathematical model restrained by a seat belt and shoulder harness. A nonlinear finite element capability was added to enable modeling of a seat which would interact realistically with the occupant. A new differential equation solver was developed which achieved a 60% reduction in the computer time required for the transient response analysis. The modified program incorporates user aids such as free-field data input and an on-line data edit capability. Output was reformatted to provide user-selected time history and occupant configuration plots as well as readable printout.

by R. N. Karnes; J. D. Sebastian; J. L. Tocher; D. W. Twigg  
Boeing Computer Services, Inc., Seattle, Wash.

Contract N00014-72-C-0223  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p154-63  
Rept. No. SAE-740331 ; 1974 ; 8refs  
Availability: In HS-015 706

HS-015 722

### THE ROLE OF FINITE DEFORMATION ANALYSIS IN PLANE STRESS AND STRAIN FRACTURES

A full nonlinear analysis, geometric as well as constitutive, of cracked plates in plane stress and strain is given. The theory is formulated in a Lagrangian frame of reference. The Newton-Raphson method is used to solve for generalized displacements in the resulting nonlinear equilibrium equations. An elastic-perfectly plastic behavior is assumed. An example of a plate containing a sharp crack and subjected to tensile load is solved using a developed finite element computer program. The analysis reveals the extent to which linear elastic-plastic approximation can be used with confidence. The inclusion of changes of large geometry results in higher and more intense strains directly ahead of the crack tip. Also a limited value of stress is achieved in the near crack tip zone. In general, the full nonlinear analysis presents a better representation of ductile fracture mechanisms than does linear elastic-plastic analysis.

by A. Youssef; L. G. Jaeger

University of New Brunswick  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p164-72  
Rept. No. SAE-740332 ; 1974 ; 26refs  
Availability: In HS-015 706

HS-015 723

### ELASTO-PLASTIC ANALYSIS OF STRESS IN A GAS-TURBINE WHEEL

The development of a finite element method for the elasto-plastic analysis of a gas turbine wheel under severe thermal and mechanical loads is discussed. A computer program based upon this development has been written and checked by

running sample problems for which the solutions exist in the literature. The output of the computer program gives the transient displacements and stresses for a specified set of discrete points in the structure. As an illustration of an actual application, one power turbine wheel has been analyzed by using the developed method and running the checked computer program. The method developed in this paper should serve as a useful tool in turbine wheel design and should result in improved wheel designs and extended engine durability.

by S. C. Tang; R. C. Petrof  
Ford Motor Co., Scientific Res. Staff  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL MECHANICS  
PROCEEDINGS, New York, 1974 p173-87  
Rept. No. SAE-740333 ; 1974 ; 7refs  
Availability: In HS-015 706

HS-015 724

### **LARGE DISPLACEMENT, NONLINEAR TRANSIENT ANALYSIS BY FINITE ELEMENTS**

A method is presented for the transient analysis of structures including nonlinearities in material behavior and geometry. A system of convected coordinates that rotate and translate with each element is used to simplify the governing equations so that an efficient computer code could be developed. For purposes of applying the method to problems with moderately large relative rotations within an element, this paper introduces additional terms to account for these variations of the rotation. Results are presented for a variety of elastic and elastic-plastic problems.

by T. Belytschko; R. E. Welch; R. W. Bruce  
Illinois Univ., Chicago; IIT Research Inst., Chicago, Ill.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p188-97  
Rept. No. SAE-740334 ; 1974 ; 23refs  
Availability: In HS-015 706

HS-015 725

### **STIFFNESS ANALYSIS OF SHEET METAL SHELLS UNDER CONCENTRATED LOADS**

The applicability of the finite element method in calculating both small and large deflections of sheet metal shells subject to concentrated loads in the elastic range is studied. In the small deflection case, three types of elements--the Hsieh-Clough-Tocher triangular plate element, the Felippa quadrilateral plate element, and the Dupuis triangular shell element--are used to calculate the stiffness of two simple panels (a sectional circular cylinder and a paraboloid) and a spherical cap. The calculated results show that all three elements give solutions converging to the exact shell solutions. Using meshes of 300-500 degrees of freedom, the errors of the finite element results relative to the exact values are about 5% or less. For the spherical cap, existing experimental data is also included in the comparison study. For large deflections, load-displacement curves of the spherical cap are computed for deflection up to three shell thicknesses using the Dupuis element. Measured data show that the departure of the load-displacement curve from the linear extrapolation based on its initial slope is substantial for deflections greater than one shell thickness (40% or more reduction in load). Using meshes of several hundred degrees of freedom for a quarter of the cap and several load

increment sizes, the calculated results compare reasonably well with measured data both in trend and in magnitude.

by K.-K. Chen; D. S. Fine  
General Motors Corp., Research Labs. and Chevrolet Motor Div.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p198-204  
Rept. No. SAE-740335 ; 1974 ; 9refs  
Availability: In HS-015 706

HS-015 726

### **APPLICATION OF GRID SELECTION PROCEDURES FOR IMPROVED FINITE ELEMENT STRESS ANALYSIS**

A set of procedures is presented that the stress analyst can use in laying out a finite element grid such that a near optimum mesh of elements will result. These grids lead to marked improvement in the displacement and stress estimates, especially in high gradient regions. Examples are given of direct application to problems encountered in automotive stress analysis.

by D. J. Turcke; G. M. McNeice  
Department of Civil Technology, Conestoga Coll. of Applied Arts and Technology (Canada); Solid Mechanics Div., Univ. of Waterloo (Canada)  
Grant NRCC-A-7014  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p205-16  
Rept. No. SAE-740336 ; 1974 ; 6refs  
Availability: In HS-015 706

HS-015 727

### **DIESEL ENGINE COMPONENT DESIGN USING THE FINITE ELEMENT METHOD AND INTERACTIVE GRAPHICS**

An inexpensive, flexible and convenient finite element analysis system can be implemented with limited capital and resources. A system of this nature can be a functional tool of the designer and stress analyst for the analysis of many types of mechanical components. The finite element models generated by this system can approach a high degree of complexity with a small time investment compared to the time required to do this job without the aid of the system described.

by J. M. Fleming; M. J. Percy  
Cummins Engine Co., Inc.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p217-27  
Rept. No. SAE-740337 ; 1974 ; 7refs  
Availability: In HS-015 706

HS-015 728

### **FINITE ELEMENT ANALYSIS, AN AUTOMOBILE ENGINEER'S TOOL**

As a basic prerequisite for complete development of the finite element method and its application to automotive engineering, the importance of computer analysis, experimentation and

mechanical design are illustrated and expectations with regard to finite element programming systems are shown. Explanations covering the verification of the finite element method and its qualified use as an absolutely necessary prerequisite for success are also considered. Systems used or taken into considerations by Daimler-Benz are critically reviewed and some successful computer projects conducted are presented.

by D. Radaj; A. Zimmer; H. Geissler  
Daimler-Benz A. G., Stuttgart (West Germany)  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p228-43  
Rept. No. SAE-740338 ; 1974 ; 11refs  
Availability: In HS-015 706

## HS-015 729

### A TECHNIQUE FOR CONNECTING BEAM ELEMENTS TO A PLATE MODEL OF A COMPLICATED BOX SECTION

In automobile structures some box sections cannot be adequately defined using beam finite elements. These sections require detailed plate models to represent holes and rapid changes in cross sections. Complications arise in connecting these detailed sections to those sections that can be adequately defined using beam elements. One technique for connecting the two sections is shown. An example of this technique is demonstrated on a section of an automobile frame, and the results are compared to experimental data.

by D. D. Schwerzler  
General Motors Research Labs., Warren, Mich.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p244-9  
Rept. No. SAE-740339 ; 1974 ; 5refs  
Availability: In HS-015 706

## HS-015 730

### THE FLEXIBILITY OF A TUBULAR WELDED JOINT IN A VEHICLE FRAME

An attempt is made to improve analytical predictions by accounting for the actual tubular shape in the vicinity of an automotive frame joint, without allowing for the flexibility of the weld line itself. The study uses the NASTRAN computer program. The joint region is treated as a small substructure in a model otherwise composed of bar elements. This procedure is economical because only those portions which really have to be analyzed using plate elements are so treated. Parameters investigated include joint length, and two ways of attaching a shell to adjacent bar elements. The present results reduce the worst two frequency errors, 38% and 60%, to less than 7% and 11%, respectively. This is good enough for many purposes. Residual discrepancies are believed to be due in part to actual weld line flexibility. In vibration modes involving a particular kind of bending deformation, the slightly larger discrepancies are also tentatively attributed to a nonlinear effect,

i.e., changes of cross-section shape in the relatively thin rectangular tubing used.

by J. L. Lubkin  
Michigan State Univ., East Lansing; Ford Motor Co., Dearborn, Mich.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p250-5  
Rept. No. SAE-740340 ; 1974 ; 4refs  
Availability: In HS-015 706

## HS-015 731

### FINITE ELEMENT MODEL DATA CHECKOUT WITH INTERACTIVE GRAPHICS

Features of an interactive graphics computer program which provides structural analysts with a method of inspecting and correcting the input data for a large structural analysis computer program are discussed. The structure defined by the input data is displayed on a high-speed graphics display and can be viewed in dynamic rotation, studied at a large scale, tested for correct definition, and corrected when errors are detected. The program has been found to be a great aid in correcting and verifying input data and has considerably reduced the time and cost of data preparation.

by A. Loverher  
Ford Motor Co., Dearborn, Mich.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p256-63  
Rept. No. SAE-740341 ; 1974  
Availability: In HS-015 706

## HS-015 732

### GENERATION OF FINITE ELEMENT MODELS VIA COMPUTER GRAPHICS

An interactive computer graphics program is illustrated which was developed to simplify the creation of finite element data which will be used for computerized structural analysis. Three-dimensional, part definition data in the form of basic design lines is input to the program and displayed on a cathode ray tube, and then a structural engineer creates the finite element definition using various computer graphics techniques. The procedures involved are discussed in detail, as well as the advantages over the traditional manual approach to element generation. Actual experience has demonstrated that this interactive computer graphic approach, in addition to being both accurate and reliable, is approximately 15 times faster than the tedious manual method.

by D. J. Fawcett  
Ford Motor Co., Dearborn, Mich.  
Publ: HS-015 706 (SAE-P-52), INTERNATIONAL  
CONFERENCE ON VEHICLE STRUCTURAL  
MECHANICS PROCEEDINGS, New York, 1974 p264-73  
Rept. No. SAE-740342 ; 1974 ; 2refs  
Availability: In HS-015 706

HS-015 733

**NASTRAN PLOTTING AT A REMOTE TERMINAL**

A system has been developed for obtaining NASTRAN plots using a plotter at a remote terminal. This provides the NASTRAN user with a convenient way to use the plotting capability of NASTRAN.

by J. J. Soboleski

A. O. Smith Corp., Milwaukee, Wis.

Publ: HS-015 706 (SAE-P-52), INTERNATIONAL

CONFERENCE ON VEHICLE STRUCTURAL

MECHANICS PROCEEDINGS, New York, 1974 p274-8

Rept. No. SAE-740343 ; 1974 ; 1ref

Availability: In HS-015 706

HS-015 734

**USING INTERACTIVE GRAPHICS FOR THE PREPARATION AND MANAGEMENT OF FINITE ELEMENT DATA**

Interactive graphics is discussed as an aid which eliminates the data management problems that arise when manually preparing finite element models. Line and surface data representations of sheet metal automotive stampings are displayed on a cathode ray tube, and these data are then used for building finite element models. Elements are built by creating node points with the light pen or by using automatic mesh generating techniques. By using the interactive capability, the user immediately sees the results of his modeling decisions and can make changes in his model as a result of viewing his work. The interactive graphics system allows the user to define his elements, load cases, boundary conditions, and freedom sets without worrying about the grid point or element numbers. All information is communicated through the use of either the light pen or the keyboard. As information is supplied about the model, it is stored in a data base for review and possible change. After the structure is complete, the data base is processed and the information is formatted for either of three finite element codes. Use of interactive graphics has helped to produce low error data at a rate not possible by manually modeling from blueprint data.

by R. K. Leverenz; B. L. Ng; W. D. Birchler; A. R. Periard;  
L. Esselink

General Motors Corp. Res. Labs. and Mfg. Staff

Publ: HS-015 706 (SAE-P-52), INTERNATIONAL

CONFERENCE ON VEHICLE STRUCTURAL

MECHANICS PROCEEDINGS, New York, 1974 p279-85

Rept. No. SAE-740344 ; 1974 ; 3refs

Availability: In HS-015 706

HS-015 735

**AUTOMOBILE INSURANCE LOSSES COLLISION COVERAGES. RELATIONSHIPS BETWEEN LOSSES AND VEHICLE DENSITY, 1972 AND 1973 MODELS**

Relationships between the registered vehicle density per square mile of the recorded garaging location of the automobile and collision coverage vehicle losses were examined, along with the effect of vehicle density on comparisons of losses between vehicle market classes and vehicle series. Variance of collision losses in regard to vehicle density was also studied. It was found that: the listed garaging location of vehicles is strongly associated with their collision coverage in-

surance loss experience, with vehicles listed as garaged in areas with a high vehicle density producing more frequent claims; the distribution of vehicle densities by market class showed only slight differences between the market classes, and adjusting to eliminate these differences produced only negligible changes in the claim frequencies and average loss payments for each market class; and there are fundamental relationships between collision losses and registered vehicle density per square mile, these relationships being substantially independent of vehicle market class, although somewhat changed by the improvements in the bumper designs of the 1973 models.

Highway Loss Data Inst., Watergate 600, Washington, D. C.  
20037

Rept. No. HLDI-A-2 ; 1974 ; 37p 1ref

Availability: Corporate author

HS-015 736

**SIMULATION: ITS ROLE IN DRIVER RESEARCH AND HIGHWAY DESIGN. VOL. 8**

Three papers are presented which consider the contributions that simulation is making in several aspects of highway safety research. The development of visual simulation during the past several decades is discussed, and its potential contribution to all aspects of highway safety research and especially driver training programs is described. Benefits and drawbacks of visual simulation are examined as it is presently being used throughout the highway safety field. Current applications of mathematical simulation to the process of designing highway and roadside features are also considered. A selected bibliography is included in the volume.

by P. F. Waller, ed.; M. G. Gilliland; P. Kyropoulos; T. J. Hirsch

North Carolina Univ., Chapel Hill. Hwy. Safety Res. Center  
1973 ; 143p refs

Includes HS-015 737--HS-015 740. Presented at the North Carolina Symposium on Hwy. Safety. Sponsored by the North Carolina State Univ. School of Engineering, School of Public Health, and the Highway Safety Research Center

Availability: Corporate author

HS-015 737

**APPLICATIONS OF COMPUTER-GENERATED IMAGERY TO DRIVER TRAINING; HIGHWAY RESEARCH, AND DESIGN**

The development of visual simulation is reviewed and its potential contribution to driver training programs especially is described. The technological process of Computer Generated Imagery (CGI) which translates electronic impulses from a digital computer into an image on a cathode ray tube is discussed, and its application to the study of driver behavior is noted. Its low cost is stressed. By adding the simulation of motion, various vehicle designs could be tested; by monitoring an image in slow time, experimental highway designs could be tested; and by controlling traffic conditions, student drivers could be trained safely. To develop such a simulator requires

the coordinated efforts of the various government, industry, and university communities.

by M. G. Gilliland

Publ: HS-015 736, SIMULATION: ITS ROLE IN DRIVER RESEARCH AND HIGHWAY DESIGN. VOL. 8, 1973 p1-33  
1973 ; 2refs

Availability: Bound in HS-015 736

HS-015 738

### **SIMULATORS: BOON OR BOONDOGGLE?**

Benefits and disadvantages of simulation as it is presently being used in the field of highway safety are considered. It is suggested that although simulation is capable of contributing a great deal to the research too often the focus is upon the hardware and not upon the problems. Simulation as it pertains to product development is emphasized, and the range of activities that can be classified under the heading of simulation is described. One involves a modified production car and a questionnaire whereby the investigator asks questions and records the subject's responses. More elaborate forms of simulation using more complex devices includes the moving base simulator which presents two coordinated movies and provides appropriate motion in order to test drivers' reactions to hazardous situations, etc. A recent development, which uses a TV camera mounted in an unmanned test car that is guided by remote control, has done much to provide both fidelity and flexibility in driving simulation.

by P. Kyropoulos

Publ: HS-015 736, SIMULATION: ITS ROLE IN DRIVER RESEARCH AND HIGHWAY DESIGN. VOL. 8, 1973 p35-48

1973 ; 7refs

Availability: Bound in HS-015 736

HS-015 739

### **USE OF MATHEMATICAL SIMULATIONS TO DEVELOP SAFER HIGHWAY DESIGN CRITERIA**

The current application of mathematical simulation to the process of designing highway and roadside features is discussed, and the lack of cooperative effort among researchers is noted. The mathematical models are often confusing formulas which fail to take into account the intricacies of many real-world problems. It is suggested that mathematical simulation provides a rapid and economical method to investigate the many parameters involved, and once the parameters are identified, it may be desirable to conduct a limited number of full-scale tests prior to final selection of a particular design. Derivation of the mathematical formula is described. The simulation of a number of impacts is illustrated, including vehicle/rigid barrier, vehicle/vehicle, vehicle/traffic railing, and vehicle/call box. It is shown that the intricacies of mathematical modeling have readily understandable application to problems confronted by the highway engineer, and can help in cost effective decision making.

by T. J. Hirsch

Publ: HS-015 736, SIMULATION: ITS ROLE IN DRIVER RESEARCH AND HIGHWAY DESIGN. VOL. 8, 1973 p49-99

1973 ; 26refs

Availability: Bound in HS-015 736

HS-015 740

### **SIMULATION AND SIMULATORS: A SELECTED BIBLIOGRAPHY**

Nearly 300 references are cited from the literature of the fields of mechanical engineering, automotive engineering, aerospace engineering, mathematics, medicine, psychology, education, physics, computer technology, and information science. The contents of the bibliography indicate the development of trends and possibilities in simulation, particularly those in the area of the development of computer generated graphic displays and computer driven simulators. The material in the bibliography is divided into categories of related simulation activities as they pertain to areas of highway safety: collision, driver, driver/occupant, roadway, vehicle.

by N. L. Grow, Jr.

Publ: HS-015 736, SIMULATION: ITS ROLE IN DRIVER RESEARCH AND HIGHWAY DESIGN. VOL. 8, 1973 p101-27

1973 ; refs

Availability: Bound in HS-015 736

HS-015 741

### **CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF FLORIDA, 1971 ACCIDENT YEAR**

Florida's conversion of state accident data to uniform accident data tape format for the 1971 accident year is presented. The data element availability is given along with the conversion logic and sample state materials, including accident coding instruction and record layout for 1971 and storage layout.

Safety Management Inst., Suite 709, 1660 L St., N. W., Washington, D. C. 20036

Contract DOT-HS-021-2-472

1973 ; 131p

See also HS-015 418.

Availability: Reference copy only

HS-015 742

### **CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF UTAH. 1971 ACCIDENT YEAR**

Utah's conversion of state accident data to uniform accident data tape format for the 1971 accident year is presented. The data element availability is given along with the conversion logic, and samples of state materials, including details on centralized input of traffic accident data and a coder's manual.

Safety Management Inst., Suite 709, 1660 L St., N. W., Washington, D. C. 20036

Contract DOT-HS-021-2-472

1973 ; 118p

Availability: Reference copy only



HS-015 743

**CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT.  
STATE OF VERMONT. 1971 ACCIDENT YEAR**

Vermont's conversion of state accident data to uniform accident data tape format is presented for the 1971 accident year. The data element availability is described along with the conversion logic and examples of state materials, including police reports of motor vehicle accidents, traffic accident statistics code sheet, officer's accident instruction manual, and Department of Motor Vehicles accident statistics code sheet.

Safety Management Inst., Suite 709, 1660 L St., N. W.,  
Washington, D. C. 20036  
Contract DOT-HS-021-2-472  
1973 ; 143p  
Availability: Reference copy only

HS-015 744

**CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT.  
STATE OF WASHINGTON. 1972 ACCIDENT YEAR**

Washington's conversion of state accident data to uniform accident data tape format for the 1972 accident year is presented. The data element availability is given along with the conversion logic. Examples of state materials included are the Uniform Police Traffic Collision Report coding rules for motor vehicle traffic accidents, card/tape layout, and changes in the coding rules for motor vehicle traffic accidents in 1972-1973.

Safety Management Inst., 1660 L St., N. W., Suite 709,  
Washington, D. C. 20036  
Contract DOT-HS-021-2-472  
1973? ; 119p  
Availability: Reference copy only

HS-015 745

**CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT.  
STATE OF WYOMING. 1971 ACCIDENT YEAR**

Wyoming's conversion of state accident data to uniform accident data tape format for the 1971 accident year is presented. The data element availability is given along with the conversion logic and examples of state materials, including coding form and tape file format for accident records, and revised coding instructions for accident records.

Safety Management Inst., 1660 L St., N. W., Suite 709,  
Washington, D. C. 20036  
Contract DOT-HS-021-2-472  
1973? ; 102p  
Availability: Reference copy only

HS-015 746

**AUTOMOBILE COLLISIONS. A MODULE ON  
ENERGY AND MOMENTUM**

The physics of energy and momentum is described as applied to automobile collisions. Experiments illustrating accelerated motion, centers of mass, torque and energy, and collision with

carts are described, and inelastic collisions are considered. Momentum conservation and energy loss in collisions is examined along with the impulse-momentum theory, the force between colliding bodies, collision damage and passenger safety. Learning goals related to each area of study are included.

by A. A. Strassenburg; G. Impeduglia  
State Univ. of New York, Stony Brook; Staten Island  
Community Coll., N. Y.  
Grant NSF-GZ-9320  
1974 ; 95p  
Coordinated by the American Inst. of Physics.  
Availability: Physics Dept., State Univ. of New York at  
Binghamton, Binghamton, N. Y. 13901

HS-015 747

**DRINKING AND DRIVING AFTER IT'S LEGAL TO  
DRINK AT 18**

Problems related to drinking drivers at age 18 are examined in view of recent lowering of legal drinking age statutes in at least 20 states. Caution is advised in the interpretation of data, and it is suggested that statistics can be read to support the idea that drinking by the young is causing more traffic accidents, when in fact it may not be so. Methods for double checking the statistical analyses are reviewed. It is emphasized that the majority of youth drink and the majority of youth drive and that these two activities are separate; driving after drinking is a third behavior, and participation in either or both of the first two does not necessarily lead to participation in the third. It is suggested that impaired driving among youth is a problem but that it should be kept in perspective.

by R. Zylman  
Publ: POLICE CHIEF v41 n11 p18, 20-1 (Nov 1974)  
1974  
Availability: See publication

HS-015 748

**ELECTRIC CARS--SET FOR ANOTHER COMEBACK**

The re-emergence of the electric vehicle in view of the energy crisis is examined. A historical review of its development and use is given, and aspects of this kind of centralization of energy conversion are discussed. Consideration is given to vehicle weight, vehicle air pollution, cumulative transmission loss, and various obstacles. Prototypes of American manufacturers are reported. Suggested methods for circumventing the problems associated with electric cars include providing them for intracity use only on a rental basis, or to effect a compromise in the form of a hybrid fuel electric car that would be combustion-powered on the open road and battery-powered in the cities. Worldwide automotive industry interest is assessed.

by D. M. Costigan  
Publ: ROAD AND TRACK v26 n3 p52-6 (Nov 1974)  
1974  
Availability: See publication



HS-015 749

# **SHOCK ABSORBERS FOR YOUR CAR. PT. 2: DYNAMOMETER, TRACK AND ROAD TESTS OF 10 SHOCKS ON A CORVETTE**

Evaluations of several shock absorbers for a 1974 Corvette are presented which include a laboratory session on a shock dynamometer and actual on-the-car evaluation. Consideration is given to front and rear suspension design, consistent braking problems, steady state skidpad cornering speeds, slalom and skitter-bump tests. Gabriel Striders were found to be the best shock absorbers, followed by the street Bilsteins, stock Delcos and Armstrongs. The choice is based primarily on the on-the-road evaluation of ride and control, with only secondary emphasis on the skitter-bump results because the differences among shocks in other performance tests were slight or nonexistent. No attempt was made to rate any of the shocks for durability.

by J. Dinkel  
 Publ: ROAD AND TRACK v26 n3 p65-70 (Nov 1974)  
 1974  
 Availability: See publication

HS-015 750

# **ANALYSIS OF DRIVER REACTION TO WARNING DEVICES AT A HIGH-ACCIDENT RURAL GRADE CROSSING. FINAL REPORT**

The effect on motorists of improving the warning devices at a high-accident, rural grade crossing, from eight-inch flashers to automatic gates and 12-inch flashers activated by a Marquardt speed predictor and having additional strobe lights was analyzed; suitable parameters to make the analysis were evaluated; accident history and site conditions were studied and related to motorist reaction to the system before and after; and the data collection system itself was evaluated. Spot speeds were taken at eight points on each approach to obtain an approach speed profile for various groups under various conditions after the signal system was improved. These were compared to similar data taken before system improvement. It was shown that an activated gate arm can be as effective in slowing the average approaching vehicle as a train across the road. Train and signal conspicuity were a problem and contributed to the poor accident records of older drivers. The Strobe lights made the warning system more visible after activation. Most drivers approach a grade crossing safely and mean speed of various groups shows trends but is a relatively weak parameter to test effectiveness, because it does not isolate the occasional, unsafe driver. Percent reduction of fastest cars, along with examining individual fastest cars, is a better parameter than mean speeds and decelerations to show improved effectiveness.

by E. R. Russell  
 Joint Hwy. Res. Proj., Lafayette, Ind.  
 Contract HPR-1-(11)-Pt-2  
 Rept. No. JHRP-74-16 ; 1974 ; 232p 59refs  
 Prepared in cooperation with the Indiana State Hwy. Commission and the Federal Hwy. Administration. Rept. on study: A FIELD EVALUATION OF DRIVER INFORMATION SYSTEMS FOR HIGHWAY-RAILWAY GRADE CROSSINGS.  
 Availability: Indiana State Hwy. Commission, 100 North Senate Ave., Indianapolis, Ind. 46204

HS-015 751

# **DESTINATION CHOICE MODELLING AND THE DISAGGREGATE ANALYSIS OF URBAN TRAVEL BEHAVIOR. FINAL REPORT**

A destination choice methodology is postulated that can be incorporated in an operational set of models of urban travel behavior. The model formulation presented has provision for making aggregate forecasts of types of travel behavior that the current quality of data can allow. The belief that disaggregate models developed with traditional sampling designs require smaller samples is not theoretically supported. It is argued that separate sampling, analogous to stratified sampling, be used to achieve such savings in sample size. The multinomial logit model was found to be impractical and of low predictive power in modelling the choice of specific shopping destinations. A multinomial response relation model that is proposed indicated that it is more pragmatic, given current data quality to predict types of shopping destination choice behavior. Additional market segmentation was found to be worthwhile in model development. There was the indication that only a few attitudinal factors were necessary. Empirical investigations with the methodology yielded encouraging results. The extension of destination choice modelling as a logistic discrimination problem is also discussed.

by J. A. Ansah  
 Joint Hwy. Res. Proj. Lafayette, Ind.  
 Contract HPR-1-(12)-Pt-1  
 Rept. No. JHRP-74-15 ; 1974 ; 277p 107refs  
 Prepared in cooperation with the Indiana State Hwy. Commission and the Federal Hwy. Administration. Rept. on study: A MICRO-ANALYSIS OF THE EFFECTS OF HOUSEHOLD SOCIO-ECONOMIC CHARACTERISTICS AND INDIVIDUAL ATTITUDES IN TRIP GENERATION.  
 Availability: Indiana State Hwy. Commission, 100 North Senate Ave., Indianapolis, Ind. 46204

HS-015 752

# **RTOR: WARRANTS AND BENEFITS. FINAL REPORT**

Intersection approaches utilizing the right turn on red (RTOR) maneuver were examined to identify problems and benefits related to it. Intersections in Lafayette and Indianapolis, Indiana were studied. It was found that the total number of accidents did not increase with RTOR nor did they decrease. It was also found that intersection approaches with a RTOR lane, lower speeds on the cross street had a greater usage of RTOR opportunities. No delays or hazards were encountered by pedestrians as a result of the RTOR maneuver. Delay reduction to right turning vehicles was found to exist, but no means to predict the amount of delay reduction to be expected was developed. A graphical relationship between the number of opportunities for vehicles to turn into the cross traffic, and the volume of vehicles on the cross street was developed. Suggested warrants for prohibition of the RTOR maneuver were developed. These are divided into three groups: those required for reasons of safety; those permissive for reasons of little

May 31, 1975

HS-015 757

benefit from the maneuver; and those permissive because of adverse public reaction.

by R. L. May  
Joint Hwy. Res. Proj. Lafayette, Ind.  
Rept. No. JHRP-74-14 ; 1974 ; 106p 38refs  
Thesis. Prepared in cooperation with the Indiana State Hwy. Commission.  
Availability: Indiana State Hwy. Commission, 100 North Senate Ave., Indianapolis, Ind. 46204

HS-015 753

### TESTING CRASH DUMMIES

Establishment of a laboratory designed to assure optimum opportunity to create crash dummies to meet critical specifications is described. Instrumentation includes a Polaroid kinematic camera system refined to record and analyze procedures related to testing of the thorax and knee; a head drop table; an arrested pendulum; a center of gravity table; a quantity of energy-absorbing material; a dummy-positioning seat; a hydraulic abdominal load simulator; a variety of signal conditioners and amplifiers; an inclinometer; and 18-channel oscillograph and various piezo-resistive accelerometers. The crash dummy components tested include the head, neck, thorax, knee or femur load, lumbar-spine and abdominal sac as well as tests for the c.g. location of the various segments and limbs plus weights and dimensions. Performance tests are described.

by J. L. Roshala  
Publ: AUTOMOTIVE INDUSTRIES v151 n8 p41-4 (15 Oct 1974)  
1974  
Availability: See publication

HS-015 754

### D. D. French; D. L. Woods

The use of inertia barrier systems has increased and analysis procedures using the conservation of momentum principle have been included in the highway safety literature, but the design of inertia barrier systems has been dependent upon the recommendation of the manufactures or upon direct field tests. This paper provides a comparatively simple yet logical approach to designing inertia barrier systems with respect to the deceleration associated with impacting various modules of the system. Equations are given.

Publ: TRAFFIC ENGINEERING v44 n13 p23, 26, 28-9 (Oct 1974)  
1974 ; 3refs  
Availability: See publication

HS-015 755

### TIRE DEFORMATION DURING DYNAMIC HYDROPLANING

Analytical and experimental confirmation is presented for the theory that tire carcass deformation is necessary for the dynamic hydroplaning of pneumatic tires. The ways in which

the results can be used to assist in studying the effects of the tire carcass and tread pattern on wet traction are discussed.

by A. L. Browne  
General Motors Corp., Res. Labs., Warren, Mich.  
Rept. No. GMR-1701 ; 1974 ; 26p 12refs  
Availability: Corporate author

HS-015 756

### THE EFFECT OF SPEED ON TRUCK FUEL CONSUMPTION RATES

Information on the effect of speed on the rates of fuel consumption of heavy-duty highway trucks was obtained. The tests were not designed to elicit the maximum fuel economy from the trucks used; and the trucks were not necessarily representative of optimized combinations of engines, power train and load. No effort was made to compare the advantages or disadvantages of one vehicle versus another. Differences in engine horsepower, transmissions, and other optional equipment offered to the purchaser by the manufacturer and in fact used on the test vehicles would make such comparison unwarranted. For this reason and because of other factors, such as original cost, longevity, frequency and type of maintenance and repairs, resale value, dependability, employee relations (driver satisfaction), suitability for particular performance (trip travel time), type of service, or other factors, the information in this report should not be interpreted as implying an advantage or disadvantage of one vehicle over another.

by E. M. Cope  
Federal Hwy. Administration, Washington, D. C.  
1974 ; 15p 1ref  
Availability: Corporate author

HS-015 757

### A PROPOSED NEW NATIONAL SYSTEM FOR COLLECTING MULTIPURPOSE ACCIDENT DATA: SIR

The current federal highway traffic accident data collection system does not produce representative data essential for answering cause and effect questions concerning accidents, injuries and fatalities, and it does not produce adequate data essential for conducting cost benefit analyses of changes in vehicle designs, highway designs, or driver licensing policies. A proposed federal data collection system (SIR) can solve those problems at a total cost of about \$6 million per year. The system would include 30 investigating teams precisely located throughout the U.S., and would include a sampling program, an in-depth program, and a rapid response program. The sooner this system is established, the sooner government and industry will begin to obtain accurate and reliable answers to pressing questions in the field of highway safety.

by J. O'Day  
Publ: HIT LAB REPORTS v4 n12 p1-8 (Aug 1974)  
Rept. No. Ref: UM-HSRI-SA-734 ; 1974 ; 2refs  
Presented at the 5th International Technical Conference on Experimental Safety Vehicles, London, 3-7 Jun 1974. Based on Final Report: "Statistical Inference from Multidisciplinary Accident Investigation," DOT-HS-031-2-350 J. O'Day, Mich. Univ., Ann Arbor, Hwy. Safety Res. Inst.  
Availability: See publication

HS-015 758

### **FLEXIBLE WORKING HOURS. A STUDY OF AN EXPERIMENT IN FLEXIBLE WORKING HOURS TO DETERMINE CHANGES IN TRAVEL PATTERNS**

A brief background is provided on the aims and development of flexible working hours. Questionnaires were distributed to all employees of a Wellington insurance company both before and after the company adopted an experiment with flexible working hours. The questionnaires sought to determine the effect of the experiment on travel patterns to and from work. Over half of the replies indicated a change in the pattern of travel, some coming earlier and some later. Flexible working hours were also found to reduce the heavy loads on buses and to increase the number of car passengers. Car drivers and train passengers remained at similar levels.

by M. J. Jackett; C. G. Laurenson; M. R. Blakeley  
Ministry of Transport, Road Transport Div., Wellington, New Zealand  
1974 ; 22p  
Availability: Traffic Engineering Section, Road Transport Div., Ministry of Transport, Private Bag, Wellington, New Zealand

HS-015 759

### **AN ANALYSIS OF TRAFFIC ACCIDENTS IN NEW ZEALAND**

The pattern of accidents and their causal factors in New Zealand is examined as part of a road safety program. Aspects of such a program should involve road improvement and signposting, education, and enforcement. A new traffic accident report form for injury accidents was introduced in 1970 which makes available a new selection of accident data. Some of the salient features of New Zealand's accident pattern are revealed by analysis of the accident statistics derived from it. A few practical conclusions suggested by the analysis are described together with reference to more detailed investigations into particular accident problems. Specific consideration is given to accident costs, benefit analysis, accident types, time of day and road conditions, and obstacles struck.

by M. R. Palmer  
Ministry of Transport, Road Transport Div., Wellington, New Zealand  
Rept. No. Traf-Res-Cir-5 ; 1974 ; 19p 3refs  
Availability: Traffic Res. Section, Road Transport Div., Ministry of Transport, Private Bag, Wellington, New Zealand

HS-015 760

### **THE EFFECT ON TRAFFIC ACCIDENTS OF EXTENDED TRADING HOURS AT HOTELS**

The change in accident patterns which followed the extension of trading hours at New Zealand hotels is analyzed. The four hour extension from 6 pm to 10 pm produced a significant change in the time distribution of accidents. There was also a significant change in the daily distribution of accidents but this was not entirely due to the different drinking hours. Despite the changes in the times of occurrence of accidents, there was no overall increase in total number. In the year that extended hours were introduced there was a reduction in accidents, and although it is considered that the prevailing economic condi-

tions were largely responsible, the possibility that liberalized drinking hours contributed cannot be excluded.

by J. B. Toomath; T. Nguyen  
Ministry of Transport, Road Transport Div., Wellington, New Zealand  
1974 ; 20p 3refs  
Availability: Traffic Res. Section, Road Transport Div., Ministry of Transport, Private Bag, Wellington, New Zealand

HS-015 761

### **TRAILER POINTERS AND DRIVING HINTS FOR PASSENGER CAR OWNERS**

Trailer pointers and driving hints for passenger car owners interested in the purchase or rental of trailers, not mobile homes, trucking or truck trailers, are offered. Part 1 contains facts, practical information, and regulations about the necessary equipment and insurance for the use and maintenance of both the trailer and the towing vehicle. Part 2 is devoted to the new driving skills which a motorist needs for pleasant and safe car and trailer operation. Basic guidelines deal with: laws and regulations: capacity, efficiency and strain on the towing vehicle; trailer attachment, positioning, loading, and alignment; liability and insurance; care and maintenance; electrical equipment; state load capacity; and emergency trailer equipment. Driving techniques include cornering, overtaking and passing, slowing and stopping, and backing.

American Automobile Assoc., Washington, D. C. Traf.  
Engineering and Safety Dept.  
Rept. No. AAA-3210 ; 1964 ; 29p  
Availability: Corporate author

HS-015 762

### **HYDROGEN-ENRICHED GASOLINE FOR AUTOS**

A system designed to operate below the lean flammability limit of gasoline is described which is being evaluated by Jet Propulsion Laboratory and which has the potential of meeting the EPA 1977 emissions standards for spark ignition engines while improving fuel economy compared to uncontrolled systems. It uses current fuels and engines and is designed to have response characteristics similar to those of conventional systems. The method is based on the addition of small quantities of gaseous hydrogen to the primary gasoline to permit combustion of the fuel mixture at ultralean conditions, with overall fuel-air mixtures significantly leaner than stoichiometric. The system can produce very low oxides of nitrogen and carbon monoxide emissions, but hydrocarbon emissions are still somewhat high.

Publ: AUTOMOTIVE ENGINEERING v82 n10 p52-6 (Nov 1974)

Based on "Feasibility Demonstration of a Road Vehicle Fuel with Hydrogen-Enriched Gasoline," by F. W. Hoehn and M. W. Dowdy. Presented at the Intersociety Energy Conversion Engineering Conference, 26-30 Aug 1974, San Francisco.  
Availability: See publication

May 31, 1975

HS-015 763

### DESIGNING TRUCK DISC BRAKES

Various design approaches to disc brakes for trucks are reviewed along with an actual disc brake system which meets the requirements of FMVSS 121. General design considerations include lining area, piston retraction, oil-cooled multiple disc brakes and air-actuated disc brakes. The new disc brake system described utilizes a new and larger sized caliper to accommodate the largest air-braked front axle. Design analysis resulted in a rotor diameter of 15.62 in. with 1.75 in. rotor thickness including a remachining and wear allowance of 0.120 in. A U-type rotor mount section allows mounting of the rotor to existing brake drum mounting surfaces. All common rim sizes could still be used. Although the basic caliper configuration was kept the same, particular attention was paid to strength, rigidity, and fluid displacement needs since it was estimated that a 23/1 air-over-hydraulic intensifier would be required to meet the torque needs for front axles up to 20,000 lb. Torque output from 60 mph was generally as predicted from past experience, and stability under conditions of extreme deceleration was outstanding compared with other types of brakes. Fade performance was excellent, and computer-based predictions on caliper strength, torque plate strength, and attachment requirements proved to be generally correct.

Publ: AUTOMOTIVE ENGINEERING v82 n10 p40-7, 78  
(Nov 1974)  
1974

Based on SAE-740602, "Disc Brakes Take on the Heavies," by W. T. Birge and K. H. Rinker, and SAE-740604, "Design Approaches to Truck Disc Brakes," by F. B. Airheart. Presented at West Coast Meeting, Anaheim, Calif., 12-16 Aug 1974.

Availability: See publication

HS-015 764

### ACCIDENT STUDY RAISES QUESTIONS ON 55 MPH NATIONAL SPEED LIMIT

Although traffic speeds, volumes and accidents went down in early 1974, engineers have found that all three are creeping up again. Speeds are still down from 1973, although the energy-crisis-motivated reduced national 55 mph speed limit did not bring average speeds all the way down to 55, but to a range of 55 to 60 mph. An important side effect of the 55 mph law was to reduce the wide disparity of speeds on any given highway, providing greater uniformity in vehicle speeds. Travel reductions are cited as well as a decrease in the number of drivers 24-and-under involved in fatal accidents, which may indicate a decrease in mileage logged by a group characterized by a disproportionately high percentage of accident involvement. It is noted that speed reductions alone cannot cause a reduction in traffic deaths, and that in fact vehicles are travelling more than 55 mph. Studies of accident rates on rural roads are cited.

Highway Users Federation for Safety and Mobility,  
Washington, D. C.

Publ: EDITOR'S RESOURCE, 7 Aug 1974  
1974 ; 5p

Availability: Public Information Div., Highway Users  
Federation, 1776 Massachusetts Ave., N. W., Washington, D.  
C. 20036

HS-015 767

HS-015 765

### PEDESTRIAN BEHAVIOR AT SIGNALISED INTERSECTIONS

In 1972 and 1973, pedestrian behavior was studied at 24 crosswalks of signalized intersections in central business districts of four cities during about 5000 cycles by time-recorder measurements and television analysis with special respect to wrong behavior patterns. Collected data were evaluated by different methods, mainly by multiple correlation and regression analysis. The main results are that wrong pedestrian behavior is favored or even stimulated by inappropriate signal timings for vehicle traffic as well as for pedestrian traffic. An amber light for pedestrians, the duration of which is equivalent to the clearance time of pedestrians, has proved to be better than signal timings without amber lights. Additional studies of accidents at crosswalks with different signal timings should be carried out.

by H.-G. Retzko; W. Androsch  
Publ: TRAFFIC ENGINEERING AND CONTROL v15  
n16/17 p735-8 (Aug-Sep 1974)  
1974

Availability: See publication

HS-015 766

### REVIEWING THE BASICS

Basic driving skills are reviewed as a means of self-evaluation of driver behavior. Consideration is given to: city driving; freeway driving (entering, driving, exiting); braking, including knowledge of the brake system, how to overtax your brakes, preventive care, and braking action; and driving around curves.

Publ: DRIVER v8 n5 p1-7, 19 (Oct 1974)  
1974

Availability: See publication

HS-015 767

### ALL ABOUT CATALYTIC CONVERTERS. HOW THEY WORK AND WHAT YOU CAN EXPECT IN PERFORMANCE

Catalytic converters' operational characteristics and performance are reviewed, and the necessity for using them is revealed in descriptions of the amounts of waste gases eliminated by the exhaust system. It is suggested that emission control systems containing catalysts offer the best means for meeting future automotive emission requirements. Design features are illustrated and explained along with system operation and catalyst problems such as cost and heat absorption into the passenger compartment. Good and bad features of emission control systems are examined. It is noted that reduced engine performance must be expected.

by A. N. Weiner

Publ: PICKUP, VAN AND 4WD v3 n3 p35-8 (Dec 1974)  
1974

Availability: See publication

HS-015 768

# **POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. REPORT TO THE CONGRESS**

Major findings of the study of vehicle fuel economy potential are examined. It is practicable to achieve, by a variety of means, a 20% improvement in the new model fleet of 1980 compared to 1974 with little further price increase. Fuel economy improvements obtained while simultaneously achieving interrelated objectives such as low emissions and occupant safety will involve competition for capital, expertise, and other resources. Impacts include price increases, increased shift to smaller cars and possible increased injury rates, achievement of the statutory emission standards for hydrocarbons and carbon monoxide, and fuel economy improvements. Several alternative federal strategies are examined in terms of their effects on producers and consumers, and ease and cost of their administration.

Department of Transp., Washington, D. C.; Environmental Protection Agency, Washington, D. C.  
1974 ; 124p refs  
Availability: Corporate authors

HS-015 769

# **USER'S MANUAL FOR UCIN VEHICLE-OCCUPANT CRASH-STUDY MODEL**

This technical report is a user's manual for the UCIN vehicle-occupant, crash-study, computer program model. The manual briefly describes the model and the range of applicability of the program. It provides detailed instructions regarding the card coding of input data, and discusses the interpretation of the output results. A sample listing of input data is also provided.

by C. E. Passerello; R. L. Huston  
Univ. of Cincinnati, Cincinnati, Ohio 45221  
Contract N00014-72A-0027-0002  
Rept. No. ONR-US-EA-050174-2-TR ; 1974 ; 30p 1ref  
Report for 15 Mar 1974 - 1 May 1974. Prepared for the Office of Naval Research, Dept. of the Navy, Arlington, Va.  
Availability: Corporate author

HS-015 770

# **DIGITAL COMPUTER**

Applications of the digital computer are examined as part of the Urban Traffic Control System (UTCS) project. Historical background is provided for twentieth century traffic control methods, followed by approaches to improving transportation network flow. In the UTCS system on-street vehicle detectors and a centrally located digital computer regulate traffic control devices within the controlled area, with reliability and cost effectiveness sufficient enough to allow future modification and expansion. The computer has a 65,000 word main magnetic core memory featuring one-microsecond random access. The map display gives the operator real-time information about the system through illuminated symbols superimposed on a map of

the UTCS area. The operator can control the kind of information displayed to suit his needs.

Sperry Rand Corp., Philadelphia, Pa. Sperry Systems Management Div.  
Rept. No. PB-202 365 ; 1970 ; 35p  
Prepared for the Bureau of Public Roads, Federal Hwy. Administration.  
Availability: NTIS

HS-015 771

# **CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. COMMONWEALTH OF PUERTO RICO. 1971 ACCIDENT YEAR**

Puerto Rico's conversion of state accident data to uniform accident data tape format for the 1971 accident year is presented. The data element availability is given along with the conversion logic and specific commonwealth materials, including the codification manual of traffic accidents and a traffic accidents analysis coding sheet.

Safety Management Inst., 1660 L St., N. W. Suite 709, Washington, D. C. 20036  
Contract DOT-HS-021-2-472  
1973 ; 133p  
Availability: Reference copy only

HS-015 772

# **CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF MINNESOTA. 1972 ACCIDENT YEAR**

Minnesota's conversion of state accident data to uniform accident data tape format for the 1972 accident year is presented. The data element availability is given along with the conversion logic and examples of state materials, including police reports, accident records year-to-year data tape file, accident tape record layout, place name listing, and flowcharting worksheet.

Safety Management Inst., 1660 L St., N.W., Suite 709, Washington, D. C. 20036  
Contract DOT-HS-021-2-472  
1973 ; 106p  
Availability: Reference copy only

HS-015 773

# **CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF MISSOURI. 1972 ACCIDENT YEAR**

Missouri's conversion of state accident data to uniform accident data tape format for the 1972 accident year is presented. The data element availability is given along with the conversion logic and sample state materials, including file description, record specifications, and a statewide traffic accident records system.

Safety Management Inst., 1660 L St., N.W., Suite 709, Washington, D. C. 20036  
Contract DOT-HS-021-2-472  
1973 ; 120p  
Availability: Reference copy only

May 31, 1975

HS-015 782

HS-015 774

**CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT.  
STATE OF MONTANA. 1972 ACCIDENT YEAR**

Montana's conversion of state accident data to uniform accident data tape format for the 1972 accident year is presented. The data element availability is given along with the conversion logic and examples of state materials, including the highway information system, violation code, and accident report.

Safety Management Inst., 1660 L St., N.W., Suite 709,  
Washington, D. C. 20036  
Contract DOT-HS-021-2-472  
1973 ; 251p  
Availability: Reference copy only

HS-015 775

**CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT.  
STATE OF WISCONSIN. 1973 ACCIDENT YEAR**

Wisconsin's conversion of state accident data to uniform accident data tape format for the 1973 accident year is presented. The data element availability is given along with the conversion logic and samples of state materials, including the uniform accident data system, layouts and data codes, motor vehicle accident report, and record layout worksheets.

Safety Management Inst., 1660 L St., N.W., Suite 709  
Washington, D. C. 20036  
Contract DOT-HS-021-2-472  
1974 ; 109p  
Availability: Reference copy only

HS-015 776

**TRAFFIC INFORMATION SYSTEM. PHASE 3. FINAL  
REPORT**

A Los Angeles project for developing an advanced computerized traffic information system capable of providing timely, relevant, and meaningful information pertaining to the traffic accident and enforcement problem is described. Four subsystems are included: accident/enforcement, traffic officer beat generation, generalized retrieval, and officer performance. Problems and recommendations are offered regarding beat experiments, personnel requirements, processing turnaround, and flexible reports. The results are discussed in terms of each subsystem and the field experiments.

Advanced Systems Development Section, Los Angeles Police Dept.  
Rept. No. TR-69-012(004) ; 1972 ; 125p  
Prepared for the Office of Traf. Safety, Business and Transp. Agency, Sacramento, Calif. Sponsored by the State of Calif. and the National Hwy. Traf. Safety Bureau.  
Availability: Office of Traf. Safety, Business and Transp. Agency, P. O. Box 865, Sacramento, Calif. 95804

HS-015 780

**AN EVALUATION OF CALIFORNIA'S "GOOD  
DRIVER" INCENTIVE PROGRAM. ABSTRACT**

California Dept. of Motor Vehicles, Sacramento, Res. and Statistics Section  
Contract FH-HPR-PR-1(9)-BO146; IA-A13306  
1974 ; 17p  
Sponsored by the Federal Hwy. Administration and the Calif. Dept. of Transp., Div. of Hwys. For full rept. see HS-015 781.  
Availability: California Dept. of Motor Vehicles, Res. and Statistics Section, P. O. Box 1828, Sacramento, Calif.

HS-015 781

**AN EVALUATION OF CALIFORNIA'S "GOOD  
DRIVER" INCENTIVE PROGRAM. FINAL REPORT**

Drivers who were free of collisions and convictions over a one year prior period were sent a letter notifying them of a 12-month license extension issued as a reward for this accomplishment. They were also told that at the end of the following year should their records again be clean, they would be recontacted and given a second extension. The results of this reward program indicated no reliable influence on subsequent traffic convictions and various detrimental effects on subsequent collisions compared to uncontact controls. Drivers having one or more prior entries were involved in an incentive program and were sent a letter describing their eligibility for a 12-month license extension which would be granted provided their records remained free of collisions and convictions over the subsequent year. The results of this incentive program indicated no significant effects on subsequent convictions, but various beneficial effects on subsequent collisions compared to controls.

by R. M. Harano; D. E. Hubert  
California Dept. of Motor Vehicles, Res. and Statistics Section, P. O. Box 1828, Sacramento, CA 95809  
Contract FH-HPR-PR-1(9)-BO146; IA-A13306  
Rept. No. CAL-DMV-RSS-74-46 ; 1974 ; 39p 15refs  
Sponsored by the Federal Hwy. Administration and the Calif. Dept. of Transp., Div. of Highways. For abstract rept. see HS-015 780  
Availability: Corporate author

HS-015 782

**CRASH TESTS AND EVALUATION OF SINGLE POST  
HIGHWAY SIGNS. INTERIM REPORT**

Seventeen full-scale vehicle crash tests were conducted to evaluate single post roadside signs such as mile post markers, route marker, destination, stop, and one-way signs. Some of the signs were equipped with breakaway devices such as threaded pipe couplings and multi-directional slip bases. Other signs were mounted on delineator posts and small diameter pipe which bent down on vehicle impact. The test vehicles were 1965 Ford sedans weighing approximately 4000 lb. The vehicles were towed into the signs at nominal impact speeds of 30, 45, and 60 mph. High speed photography was used as the primary source of data acquisition. The initial vehicle impact with all signs was relatively minor with change in vehicle speeds ranging from 0.5 mph to 2.6 mph. Some potentially hazardous secondary collisions of the signs with the vehicle's

windshield and roof were found. Recommendations to minimize or eliminate this secondary collision were set forth.

by T. J. Hirsch; J. W. Button; E. Buth  
Texas Transportation Inst., Texas A and M Univ., College Station, Tex. 77843  
Grant RS-2-10-68-146  
Rept. No. RR-146-11; TTI-2-10-68-146-11 ; 1973 ; 95p 2refs  
Sponsored by the Texas Hwy. Dept. in cooperation with the Federal Hwy. Administration. Rept. for Sep 1968-Aug 1973 on Studies of Field Adaptation of Impact Attenuation Systems.  
Availability: Corporate author

HS-015 783

### **SPEED/FLOW RELATIONS ON RECREATIONAL ROADS**

Measurements were made during the summer of 1973 of speed/flow relations for traffic on improved and unimproved sections of the A66 Penrith-Cockermouth road. This work formed part of a study being undertaken to establish whether there is a difference between speed/flow relations for recreational and other rural roads. Observed speeds appeared to be more than 10% lower than speeds predicted by established methods for rural roads of comparable standard outside recreational areas.

by J. A. Forsgate; J. N. Hammond  
Transport Systems, Transport and Road Res. Lab., Crowthorne, Berks., England  
Rept. No. TRRL-LR-638 ; 1974 ; 16p 3refs  
Availability: Corporate author

HS-015 784

### **EXAMINATION OF ALCOHOL INTOXICATION IN CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A MATHEMATICAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE RESULTS OF CLINICAL EXAMINATION AND BLOOD ALCOHOL**

Clinical examinations of 494 suspected drunk drivers were examined and correlations of the test results with blood alcohol and the estimated degree of intoxication were determined. In the subjects with blood alcohol lower than 1.51% the correlations of nystagmus tests with blood alcohol were on the same order as that in the total sample, whereas the correlations between the test results of the other tests and blood alcohol were significantly lower. The nystagmus phenomena proved to be the best tests when regression analysis was used in the estimation of the blood alcohol level on the basis of clinical observations. The result of regression analyses on the total sample indicated that in addition to nystagmus tests, walking along a line, walking test with eyes closed, Romberg's test with eyes open, collecting small objects test, counting backwards test, orientation as to time, finger-finger test, and gait in turning were adequate in decreasing order. The tests that were based purely on subjective estimation of the phenomenon were of no value. The results of a clinical examination and blood alcohol were combined using summation or multiplication methods.

by A. Penttilä; M. Tenhu; M. Kataja  
Central Organization for Traffic Safety in Finland  
Rept. No. LIKENNETURVA-15 ; 1974 ; 82p 41refs  
Sponsored by Alkoholitutkimussäätiö and the National Res. Council for Medical Sciences of Finland.  
Availability: Liikenneturva, Iso Roobertinkatu 20, 00120 Helsinki 12, Finland

HS-015 785

### **DETECTION OF FREEWAY CAPACITY-REDUCING INCIDENTS BY TRAFFIC-STREAM MEASUREMENTS**

The feasibility of using freeway traffic flow data compiled by electronic surveillance and control systems for the detection of accidents and other lane blockage incidents that temporarily disrupt traffic flow is investigated. Research conducted in Detroit where traffic data consisted of one minute compilations was of volume and occupancy recorded by ultrasonic presence detectors. Nineteen detection algorithms, including one being used in Los Angeles, were evaluated with a sample of 50 representative afternoon peak period incidents. The technique of exponential smoothing of occupancy or volume data to detect incident generated shock waves was found to be the most effective. This algorithm detected 42% of the incidents with virtually no false alarms and every incident with an 8% false alarm rate. Most of the incidents were detected within one minute of the onset of congestion at a detector station. Algorithm effectiveness was not affected by detector spacings ranging from 1460 to 4815 ft, volumes from 1200 to 2000 vhp per lane, occupancies from 9% to 45%, precipitation, or the particular lane blocked. The algorithms could not distinguish accidents from less serious incidents, but because they directly related each incident to its impact on traffic operations their incorporation in control systems could improve system response to incidents.

by A. R. Cook; D. E. Cleveland  
Publ: TRANSPORTATION RESEARCH RECORD n495 p1-24 (1974)  
1974 ; 9refs  
Sponsored by the TRB Com. on Freeway Operations.  
Prepared in cooperation with the Texas Transp. Inst., the Texas Hwy. Dept. and the Federal Hwy. Administration.  
Availability: See publication

HS-015 786

### **PERFORMANCE OF VOLUNTEER MONITORS USING CITIZENS BAND RADIO FOR A HIGHWAY COMMUNICATIONS SERVICE**

A two-year study of the performance of Ohio REACT volunteer monitors using Citizens Band (CB) radio to provide a highway and emergency communication service has been completed. The report describes how CB radio is used for aid and information purposes. Measured performance data are used to analyze monitoring coverage in the state. It is shown that in Ohio volunteer CB monitors annually contribute a public service having an economic value of approximately \$10.2 million.

by W. G. Trabold; G. H. Reese  
Publ: TRANSPORTATION RESEARCH RECORD n495 p25-34 (1974)  
1974 ; 7refs  
Sponsored by the TRB Com. on Communications.  
Availability: See publication



## **STUDY OF DETECTOR RELIABILITY FOR A MOTORIST INFORMATION SYSTEM ON THE GULF FREEWAY**

An experimental warning system installed on the Gulf Freeway in Houston as a means of alerting drivers approaching crest type of vertical curves to stoppages downstream of the crest is described. Successful automatic operation of the warning system depends on the reliability of system components. A one-lane control criterion resulted in 100% detection; 96% of the waves were detected using a two-lane control criterion. The studies also indicated a relatively high frequency of detector failures. The frequency of detector failures prompted a study to evaluate reliability of the warning system based on detector failure and repair rates experienced on the Gulf Freeway surveillance and control system and to ascertain whether detector redundancy or improved maintenance would be necessary. The reliability in terms of availability of the safety warning system was analyzed. Availability of the system was 0.95 and 0.995 for the one- and two-lane criteria respectively. The results indicated that the current detector configuration and maintenance practices were adequate.

by C. L. Dudek; C. J. Messer; A. K. Dutt  
 Publ: TRANSPORTATION RESEARCH RECORD n495 p35-43 (1974)  
 1974 ; 4refs  
 Sponsored by the TRB Com. on Freeway Operations. Prepared in cooperation with the Texas Transp. Inst., Texas Hwy. Dept. and the Federal Hwy. Administration.  
 Availability: See publication

HS-015 788

## **DESIGN OF DENSITY-MEASURING SYSTEMS FOR ROADWAYS**

A Kalman filtering methodology for the estimation of traffic densities on multilane roadways is tested by using aerial photography data. The method gives very satisfactory estimates even when the sensor separation is as great as 3000 ft. Contrary to intuition, the minimum achievable error of the density estimation algorithm is not necessarily a strictly increasing function of the distance between sensors, but the variation of this error versus sensor separation may have a flat region, offering an opportunity for substantial savings in sensor cost. A systematic procedure is given for designing and calibrating a density measuring system for a roadway.

by D. C. Gazis; M. W. Szeto  
 Publ: TRANSPORTATION RESEARCH RECORD n495 p44-52 (1974)  
 1974 ; 6refs  
 Sponsored by the TRB Com. on Freeway Operations.  
 Availability: See publication

HS-015 789

## **INVESTIGATION OF FLOW-DENSITY DISCONTINUITY AND DUAL-MODE TRAFFIC BEHAVIOR**

The investigation of traffic behavior was based on an unusually strong data set: data taken from a two-lane expressway with only one ramp operation in the seven-mile length. Truck and bus traffic was not allowed to operate on the two-

lane expressway, and the data set spanned a seven hour period and reflected all phases of traffic behavior. Autocovariance functions indicated random flow-density behavior for occupancy less than 15% (free-flow behavior). The autocovariance functions for higher occupancies indicated varying degrees of Markovian behavior. Cross-covariance analysis indicated that, under free-flow conditions, disturbances in the traffic stream were propagated with the flow of traffic at nearly the free-flow traffic speed. Analysis of flow-density behavior yielded distinct and discontinuous ranges of linear and nonlinear behavior. Further investigation through multivariate discriminant analysis indicated that, although density was the more important parameter, a flow-density criterion function was superior to a simple density criterion function. Such a flow-density criterion function would change over time because of differences in the breakdown and recovery processes.

by B. D. Hillegas; D. G. Houghton; P. J. Athol  
 Publ: TRANSPORTATION RESEARCH RECORD n495 p53-63 (1974)  
 1974 ; 10refs  
 Sponsored by the TRB Com. on Freeway Operations and the TRB Com. on Traffic Flow Theory and Characteristics.  
 Availability: See publication

HS-015 790

## **ALGORITHM FOR A REAL-TIME ADVISORY SIGN CONTROL SYSTEM FOR URBAN HIGHWAYS**

To reduce acceleration noise and thereby accident probability, an on-highway traffic-responsive control system is proposed that transmits advance warning of impending slowdowns. The control system output consists of command settings for advisory speed signs that are spaced along the highway at intervals of 0.1 mile. The derivation of the sign control algorithm that culminates in a formula expressing the speed setting of an advisory sign in terms of the detected speed and vehicle-count data is detailed. The control algorithm is designed to influence the trajectory of a vehicle at times of impending slowdowns such that its contribution to the acceleration noise integral is minimized. Examples are presented that show the application of the sign setting algorithm to hypothetical traffic situations.

by S. Kleinman; R. Wiener  
 Publ: TRANSPORTATION RESEARCH RECORD n495 p64-74 (1974)  
 1974 ; 6refs  
 Sponsored by the TRB Com. on Freeway Operations. Report is part of Doctoral dissertation. Supported in part by the City Univ. of New York and by the New York State Science and Technology Foundation.  
 Availability: See publication

HS-015 791

## **OPTIMIZATION TECHNIQUES APPLIED TO IMPROVING FREEWAY OPERATIONS**

Optimization techniques are described that have been developed and applied for evaluating freeway operational improvements such as redesign or ramp control strategies. First, a deterministic macroscopic simulation model is described that predicts the traffic performance on a directional freeway as a function of freeway design and traffic demand patterns. Then two decision models are presented that automatically work with the simulation model to select optimum redesign or ramp control strategies. Finally, a freeway corridor model is



described. Emphasis is given to the structure of the model and to the first step in the development of the freeway corridor model, which is a major arterial street model.

by A. D. May  
 Publ: TRANSPORTATION RESEARCH RECORD n495 p75-91 (1974)  
 1974 ; 22refs  
 Publication sponsored by the TRB Com. on Freeway Operations. Study sponsored by the Calif. Div. of Hwys. and the Dept. of Transportation.  
 Availability: See publication

## HS-015 792

### ANGLE AND SMALL-CAR IMPACT TESTS OF AN ARTICULATED GORE BARRIER EMPLOYING LIGHTWEIGHT CONCRETE ENERGY-ABSORBING CARTRIDGES

A crash attenuator for errant vehicles, employing lightweight concrete energy-absorbing cartridges, has been further tested to demonstrate its capabilities to decelerate lightweight cars without excessive loads and to deflect standard-sized automobiles in side impact at high speeds and angles. Favorable test results were experienced in all phases of the testing. A Volkswagen sedan that impacted the attenuator at 58 mph was driven away with 9 1/2 inches of maximum front-end crush. Fendering tests involving standard-sized cars traveling at speeds up to 68 mph were successfully performed, without seriously deteriorating the residual head-on capability of the attenuator. Analyses of the results show that the attenuator stroke is nearly independent of vehicle mass, causing about the same average deceleration in 60 mph head-on impacts of the 1800-lbm Volkswagen and a 3700-lbm Rambler. For impacts of the same weight vehicle at different velocities, the average deceleration is roughly proportional to the 1.6 power of impact velocity.

by G. W. Walker; C. Y. Warner; B. O. Young  
 Publ: TRANSPORTATION RESEARCH RECORD n488 p1-10 (1974)  
 1974 ; 6refs  
 Availability: See publication

## HS-015 793

### VEHICLE-ARRESTING SYSTEM USING CHAIN-LINK FENCE

Among the roadside characteristics which can be dangerous to errant high-speed vehicles that run off the roadway are medians between twin bridge approaches, dead ends, and barriers that close off entrance and exit ramps. A chain-link vehicle-arresting system was designed to prevent motorists from entering the median area between twin bridges and was tested. When the system proved a failure, it was modified by the manufacturer and retested under head-on and angle impacts. Retesting verified that dangerous median configurations could be successfully protected by a net system. It was also found that breakaway support posts would improve vehicle entrapment in the net.

by E. L. Marquis; G. G. Hayes; T. J. Hirsch  
 Publ: TRANSPORTATION RESEARCH RECORD n488 p11-8 (1974)  
 1974 ; 3refs  
 Sponsored by the Federal Hwy. Administration.  
 Availability: See publication

## HS-015 794

### AUTOMOBILES AND HIGHWAY CRASH ATTENUATORS: SYSTEM DESIGN CONSIDERATIONS

Present fixed-object casualties and scheduled future vehicle crashworthiness performance, when compared with trends toward smaller automobiles, allow rough estimation of future requirements for highway crash attenuators. Smaller, stiffer attenuators will be appropriate. An attenuator depth of eight feet will be adequate for survival of frontal crashes at speeds up to 70 mph. Whereas a constant-stroke attenuator is preferable for the same space constraints, a fixed-force system having a gradually increasing force can also provide good performance. Attenuator force for the 70 mph impact should be 75,000-85,000 lbf. The highway crash attenuator will thus provide a means to prevent casualties that vehicle systems are not able to prevent economically. In addition, the changed attenuator requirements will result in attenuator cost savings which should allow protection of two to three times as many hazard sites.

by C. Y. Warner; D. Friedman  
 Publ: TRANSPORTATION RESEARCH RECORD n488 p19-23 (1974)  
 1974 ; 22refs  
 Availability: See publication

## HS-015 795

### DEVELOPMENT OF A NEW MEDIAN BARRIER TERMINAL

New traffic barrier concepts were formulated and two were evaluated by crash tests. A guardrail breakaway cable terminal (BCT) developed previously was subjected to more extensive testing, and modifications were incorporated as indicated by test results. A new median barrier terminal that incorporated breakaway cable features was also developed and evaluated. The test terminals were subjected to both angular and end-on impacts. Impact conditions included both standard and subcompact vehicles, moderate and high speed velocities, and angles of 0 and 25 deg. Sixteen crash tests were conducted on the median barrier BCT. Crash events were documented by photography and electronic transducers. Results of the tests indicate that these new terminals provide a significant improvement in performance over other currently specified terminals. The median barrier BCT elements that collapse in accordion-like manner when impacted end-on could be used at sites such as elevated gores requiring crash cushions. The cost is substantial, but the increase in cost over existing terminal designs diminishes as the length of the barrier increases.

by M. E. Bronstad; J. D. Michie  
 Publ: TRANSPORTATION RESEARCH RECORD n488 p24-33 (1974)  
 1974 ; 9refs  
 Sponsored by the American Assoc. of State Hwy. Officials in cooperation with the Federal Hwy. Administration.  
 Availability: See publication

## CRASH TEST EVALUATION OF THRIE BEAM TRAFFIC BARRIERS

Since the mounting height of the W-beam has been shown to be critical in tests as well as field installations, background information on the conception and development of a configuration known as the Thrie beam is presented along with findings of a crash test series on this new barrier element. Basically, the Thrie beam can be described as a triple corrugated beam as compared to a double corrugated W-beam. It is 1 1/2 times the width of the W-beam, but the corrugation geometry and 3 1/4-inches depth are similar. The crash test series was conducted on blocked-out steel post median barrier and guardrail systems. Test conditions included 4500- to 2200-lbm (2.0-to 1.0-Mg) vehicles with speeds ranging from 54 to 67 mph (57 to 108 km/h) and impact angles varying from 16 to 29 deg.

by M. E. Bronstad; J. D. Michie; J. G. Viner; W. E. Behm  
Publ: TRANSPORTATION RESEARCH RECORD n488 p34-44 (1974)  
1974 ; 9refs  
Sponsored by the Anderson Safeway Guard Rail Corp., Flint, Mich.  
Availability: See publication

HS-015 797

## DEVELOPMENT OF APPROACH RAIL-BRIDGE RAIL TRANSITION USING ALUMINUM BALANCED SYSTEM

A series of four vehicle crash tests was performed during the development of an approach rail-bridge transition using the Aluminum Association balanced rail system. Nominal impact conditions for the 4000-lbm (1800-kg) cars were 60 mph (97km/h) and 25 deg; the point of impact was immediately upstream from the bridge rail end. After each test, design modifications were incorporated in the installation to improve its performance. Features that were varied during the test series include the bridge curb, transition post spacing, soil reaction plates for posts, rail cross section geometry, and rail splice details. The final design, tested in the fourth test, exhibited acceptable vehicle redirective performance. Vehicle decelerations of 6.6 (long.) and 7.8 (lat.) g are moderately high but are judged acceptable.

by J. D. Michie; M. E. Bronstad; G. Alison  
Publ: TRANSPORTATION RESEARCH RECORD n488 p49-52 (1974)  
1974 ; 2refs  
Sponsored by the Aluminum Assoc. in cooperation with Southwest Res. Inst.  
Availability: See publication

HS-015 798

## FULL-SCALE EMBANKMENT TESTS AND COMPARISONS WITH A COMPUTER SIMULATION

Some published criteria related to embankment severity and the need for guardrail protection were based on output from the Texas Transportation Institute's version of the highway-vehicle-object simulation model (HVOSM). Because HVOSM had not been validated for embankments with relatively steep side slopes and because implementation of the criteria would require changes in current Texas Highway Department design

procedures, a limited validation study was undertaken. Six full-scale automobile tests were conducted on an embankment of an in-service roadway. The embankment had a side slope of approximately 3.5:1 and a flat-bottom ditch approximately 20 ft below the roadway. A wide variety of encroachment conditions were obtained in the six tests. In addition, suspension failures and, in one case, an attempt to steer back on the side slope created special test conditions. This range of test conditions encompasses many of the conditions that occur in run-off-the-road accidents. Each test was simulated by the HVOSM, and the results were then compared with the measured test results. Three basic types of data were compared: vertical accelerations, vehicle paths, and vehicle attitudes.

by H.E. Ross, Jr.; E. R. Post  
Publ: TRANSPORTATION RESEARCH RECORD n488 p53-63 (1974)  
1974 ; 8refs  
Availability: See publication

HS-015 799

## A BREAKAWAY CONCEPT FOR TIMBER UTILITY POLES

The feasibility of modifying existing timber utility poles so that they will readily break away upon impact was investigated. Various drilled holes and groove patterns were experimentally examined during 13 pendulum tests of full-size class 4-40 poles by using a 4000-lbm (1814-kg) mass striking the specimens at 20 mph (32 km/h). Two weakened zones, located 6 inches (152 mm) above grade and 6 feet (1.8 m) from the pole top, facilitated the detachment of the 27-ft (8.2-m) center section. Based on Federal Highway Administration criteria, 400 16.s(1780 N.s) for pendulum tests, linear impulse test results of weakened and unweakened poles indicate that poles with a large probability of being struck by an errant vehicle may be easily modified to a breakaway structure. Vehicle crash tests are recommended as the next step in breakaway concept development.

by G. K. Wolfe; M. E. Bronstad; J. D. Michie; J. Wong  
Publ: TRANSPORTATION RESEARCH RECORD n488 p64-88 (1974)  
1974 ; 17refs  
Availability: See publication

HS-015 800

## PROCEDURES AND TECHNIQUES FOR PHOTOMETRIC MEASUREMENT OF GONIOMETER-MOUNTED SAE AND ECE HEADLAMPS

The equipment, procedures and techniques involved in photometric measurement of goniometer-mounted SAE and ECE headlamps employing extensive spherical photometric scans to determine headlamp characteristics under ideal test conditions are described. The system is detailed with regard to goniometer, headlamp mounting plates, telescope unit, measurement control, photometer probe cart, photometers and probes, calibration procedures, and light baffling. Operational

HS-015 801

procedures and techniques are outlined along with data reduction and analysis. Tables and illustrations are included.

by R. G. Brown; S. R. Gwilt  
National Research Council Canada. National Aeronautical  
Establishment, Ottawa, Ont. (Canada)  
Rept. No. LTR-ST-610; 1974; 108p  
Availability: Corporate author

HS-015 801

### **THE TRAFFIC CONFLICTS TECHNIQUE: AN ACCIDENT PREDICTION METHOD**

A traffic conflicts technique was developed by General Motors as a method of measuring accident potential and is based on tabulation of evasive maneuvers as evidenced by brake light indications and lane changes. For accident potential at intersections, 20 specific conflict classifications are defined. As a result of an FHWA-financed research program, Ohio became involved in the evaluation of the GM technique. At the time that the federal program ended, Ohio decided to pursue its own evaluation of the technique, prompted by a conviction that the theory behind the conflicts technique was sound and by a desire to find an accident prediction technique for use in Ohio. Early tests indicated that the algorithm published by FHWA could not be easily calibrated for Ohio data trends. During 1972 and the first half of 1973, the Ohio data base was enlarged from 196 projects to 410 projects involving 922 approaches, of which 611 were usable for analysis purposes. A series of regression models was applied to this enlarged data base in an attempt to find a reliable accident prediction model. As a result of this analysis, accident prediction algorithms were developed that provide a mean accuracy of  $\pm 1.1$  accidents per year and a 75th percentile accuracy of  $\pm 1.8$  accidents per year. In addition, substantial insight into the workings of the conflicts technique has been obtained.

by R. D. Paddock  
Publ: TRANSPORTATION RESEARCH RECORD n486 p1-  
10 (1974)  
1974; 4refs  
Sponsored by the Committee on Traffic Records.  
Availability: See publication

HS-015 802

### **TESTS FOR HAZARDOUS FAILURE OF ENERGY ABSORBING AUTOMOTIVE BUMPER CYLINDERS. REPORT**

Delco and Taylor energy absorbing bumper cylinders were tested to failure in each of four types of tests. No personnel hazard appeared to be associated with the failures which occurred under impact test conditions. High temperature oven tests and gasoline fire exposure tests produced failures on both cylinders which present hazards if a person were to contact the hot cylinder and hot fluid droplets leaking from the cylinder. Additional hazards are associated with the burning fluid from the Delco cylinders, and with the melted metal of the Taylor Devices cylinders in these two types of tests. The oxy-acetylene torch tests 01, 02 and 03 produced failures in both types of cylinders which present hazards to personnel due to the hot cylinder, the burning fluid, and hot fluid droplets. In the case of oxy-acetylene torch test 03, which was of partially compressed cylinders, cutting through the pressurized chamber (inner casing) of the cylinders produced an

HSL 75-5

additional hazard to persons in the vicinity of such activity. At the point of rupture of the cylinder wall, what appeared to be hot particulate matter spurted out several feet from the cylinder when rupture of the casing occurred.

by D. P. Miller  
General Environments Corp., 6840 Industrial Rd., Springfield,  
Va. 22151  
Contract IIHS-6540  
Rept. No. GEC-A-4348.2; 1974; 56p  
Prepared for the Insurance Inst. for Hwy. Safety, Washington,  
D. C.  
Availability: Corporate author

HS-015 803

### **LARGE-TRUCK ACCIDENTS INVOLVING TIRE FAILURE. FINAL REPORT**

Truck accidents involving truck tire failure were examined by reviewing existing literature, interviewing local cargo haulers, and analyzing several computerized accident data files. As reported in the literature, such accidents account for between 0.68% and 0.82% of all truck accidents in the U. S. Data reported by two specific cargo haulers showed that truck accidents resulting from truck tire failure account for 0.43% to 0.75% of all their recorded accidents, and that a truck accident resulting from truck tire failure occurs about once in every 10 million to 17 million truck vehicle miles. Only about one truck tire failure in 1300 to 2200 such failures results in an accident. HSRI accident data files indicated that truck accidents resulting from truck tire failure constitute from 0.02% of all accidents (all types and vehicles) in Texas to an average of about 0.9% of all accidents on the Indiana, Ohio, and Pennsylvania turnpikes. Such accidents account for about 0.9% of all truck accidents in Texas and average about 4.4% of all truck accidents on these turnpikes. Truck accidents involving front tire failures usually are a consequence of loss of control. Accidents resulting from trailer tire failures almost always involve a tire fire. In general, truck accidents resulting from tire failure were found to be so rare as to make only a minor contribution to the total body of accident statistics.

by D. F. Dunlap  
Highway Safety Res. Inst., Huron Parkway & Baxter Road,  
Univ. of Mich., Ann Arbor, Mich. 48105  
Rept. No. UM-HSRI-SA-74-7; 1974; 69p 24refs  
Prepared for the Rubber Mfrs. Assoc., Washington, D. C.

HS-015 804

### **IMPROVEMENT IN DYNAMIC CHARACTERISTICS OF AUTOMOBILE SUSPENSION SYSTEMS. PT. 2. THREE-MASS SYSTEMS**

Various configurations of the three-mass systems are studied and the results are compared to find the most promising alternatives. The gain in dynamic characteristics with respect to the two-mass systems is evaluated. The study is limited to systems with passive elements (springs and dampers) with the exception that for low-frequency suspensions, a height control mechanism would be needed to compensate for the differences in height due to variations in loading. The so-called active suspension systems using high-gain control and servo-elements can theoretically offer better vibration isolation than passive systems with springs and dampers. As the active systems do not damp the vibrations of the unsprung mass, active suspen-

sion elements should be used in three-mass systems instead of two-mass systems. The possible gain in passenger comfort to be achieved by passive low-frequency suspension is considerable, and passive suspension systems are seen as an economic solution in situations where more human comfort is needed. Transfer functions are given.

by D. Ryba  
Publ: VEHICLE SYSTEM DYNAMICS v3 n2 p55-98 (1974)  
1974 ; 5refs  
For Pt. 1 see HS-015 350.  
Availability: See publication

HS-015 805

**SCHWINGUNGSUNTERSUCHUNGEN AN EINER  
PKW-KAROSSERIE (INVESTIGATIONS INTO THE  
VIBRATIONS OF AN AUTOMOBILE BODY)**

The numerical treatment of the lower elastic vibrations of a motorcar body is presented. The displacement method has been found to be an effective technique for this calculation. When idealizing the structure it is tried to show the lower boundary for the subdivision of the structure, with which satisfying results can be obtained. The presented results show that the calculation of the vibration characteristics of a car body is possible with relatively simple model structures. It is noted that the model structure has to be constructed considering requirements made upon the results. For the calculation of the four lower vibration modes the car body is idealised with beam and triangular elements. By this method the stiffness and mass matrices are derived. The distributed mass is simply condensed to mass points in the nodes of the structure. Together with the stiffness matrix, the mass matrix is reduced to a practical size for the final computation of the eigenvalues and eigenmodes.

by E. Hilbrandt  
Publ: VEHICLE SYSTEM DYNAMICS v3 n2 p99-108 (1974)  
1974 ; 10refs  
Text in German. English summary.  
Availability: See publication

HS-015 806

**CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT.  
STATE OF OKLAHOMA. 1971 ACCIDENT YEAR**

Oklahoma's conversion of state accident data to uniform accident data tape format for the 1971 accident year is presented. Data element availability is given along with conversion logic and examples of state materials, including official police traffic collision reports, coding guides and report code sheets, and multiple-card layout form. Data uniformity in state data banks results from the conversion to the computerized records management system.

Safety Management Inst., 1660 L St., N.W., Washington, D. C. 20036  
Contract DOT-HS-021-2-472  
1973 ; 112p  
Availability: Reference copy only

HS-015 807

**CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT.  
STATE OF MISSOURI. 1971 ACCIDENT YEAR**

Missouri's conversion of state accident data to uniform accident data tape format for the 1971 accident year is presented. The data element availability is given along with the conversion logic and sample state materials, including file description, record specifications for the division of information systems, and the statewide traffic accident records system. Data uniformity in state data banks results from the conversion to the computerized records management system.

Safety Management Inst., 1660 L St., N.W., Suite 709,  
Washington, D. C. 20036  
1973 ; 120p  
Availability: Reference copy only

HS-015 808

**CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT.  
STATE OF NEW MEXICO. 1972 ACCIDENT YEAR**

New Mexico's conversion of state accident data to uniform accident data tape format for the 1972 accident year is presented. Data element availability is given along with the conversion logic and samples of state materials, including accident reports, record layouts, and a traffic accident coding manual. Data uniformity in state data banks results from the conversion to the computerized records management system.

Safety Management Inst., 1660 L St., N.W., Suite 709,  
Washington, D. C. 20036  
Contract DOT-HS-021-2-472  
1973 ; 100p  
Availability: Reference copy only

HS-015 809

**CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT.  
STATE OF NEVADA. 1972 ACCIDENT YEAR**

Nevada's conversion of state accident data to uniform accident data tape format for the 1972 accident year is presented. Data tape element availability is given along with the conversion logic and sample state materials, including file description and layouts and the traffic accident report manual. The computerized records management system permits data uniformity in state data banks.

Safety Management Inst., 1660 L St., N.W., Suite 709,  
Washington, D. C. 20036  
Contract DOT-HS-021-2-472  
1973 ; 297p  
Availability: Reference copy only

HS-015 810

HSL 75-5

HS-015 810

### **COMPRESSION OF AN INFLATED TUBE BETWEEN RIGID SURFACES AS AN ELEMENTARY TIRE MECHANICS MODEL**

An infinitely long membrane tube under lateral compression between various rigid surfaces is used as a model to illustrate the load carrying mechanism in tires. The surfaces include parallel flat plates, indentors, and surfaces which are flat and parallel except for a semicircular hump. Such configurations are relevant to deflection of tires against flat ground, the plunger test of tire behavior, and tire enveloping properties. In the flat plate case, compression rate appreciably affects both the force-deflection relations and strength. Even at its weakest, the structure bursts only at very high deflection. In the indenter case, burst cannot occur unless the initial pressure exceeds a value dependent on the indenter radius to which behavior is otherwise insensitive. Regarding envelopment, the magnitude of the disturbance due to the presence of a hump increases with decreasing tube inflation pressure.

by D. W. Nicholson  
Publ: TIRE SCIENCE AND TECHNOLOGY v2 n1 p3-17  
(Feb 1974)  
Rept. No. Goodyear-Contrib-517 ; 1974 ; 13refs  
Availability: See publication

HS-015 811

### **CONTOURING THE TIRE SIDEWALL WITH MOIRE**

Knowledge of the tire sidewall deformation is necessary for accurate modeling of the response of a pneumatic tire to applied forces. An experimental method, the moire fringe technique, is described which permits the contouring of the tire surface under all normal operating conditions. Results are presented for a series of tests which were conducted to determine the tire sidewall deformation due to static loading, centrifugal force, combined vertical and centrifugal loading, and high speed operation, during which standing waves are present in the tire sidewall.

by A. L. Browne  
Publ: TIRE SCIENCE AND TECHNOLOGY v2 n1 p18-39  
(Feb 1974)  
1974 ; 21refs  
Availability: See publication

HS-015 812

### **PATTERNS OF TREAD WEAR AND ESTIMATED TREAD LIFE**

Tire wear data from two tread wear tests on different courses have been analyzed to determine how patterns of wear are affected by the course. The coefficient of variation (CV) was used as a measure of irregular wear. Tires which exhibited irregular wear (large CV) exhibited the same pattern of wear on both courses; the location of the fastest wearing ribs was unchanged. Those that wore more evenly showed distinct differences in wear pattern on the two courses although all ribs wore at about the same rate. Some of the changes observed for particular brands of tires may have been the result of tire design changes. Tread life was projected for tires based on the fastest disappearing groove and on the average of all groove depth readings. The rankings of the tires by both methods on the two courses were highly correlated; there does not appear

to be any advantage to one method over the other for relative rating.

by F. C. Brenner; A. Kondo  
Publ: TIRE SCIENCE AND TECHNOLOGY v2 n1 p54-60  
(Feb 1974)  
1974 ; 2refs  
Availability: See publication

HS-015 813

### **ANALYSIS OF THE WEAR OF MULTISECTIONED TIRE TREADS**

The meaningfulness of multisectioned tire tests has been the subject of considerable controversy, and this exposition analysis of the data from such tests is discussed from a statistician's point of view. The applicable statistical model for analyzing such data is discussed, as well as data transformation and estimation of tire compound interaction effects. It is concluded that, given the proper analysis, multisectioned tire tests are a valid means for comparing tread wear of several compounds.

by G. C. Derringer  
Publ: TIRE SCIENCE AND TECHNOLOGY v2 n1 p61-73  
(Feb 1974)  
1974 ; 12refs  
Presented at the Winter Meeting of the Akron Rubber Group, Akron, Ohio, 1973.  
Availability: See publication

HS-015 814

### **DRIVE YOUR CAR SAFELY**

A distillation of instructional methods is presented based on experience, observation, and experimentation of a driving school instructor. Specific chapters deal with: driver education; definitions and objectives of driving; driving tasks; the highway transportation system; psychology of driving; young and old drivers; good and harmful effects of drugs on driving; role of the instructor; instruction permits and driver licenses; signs, signals and road markings; right of way; manipulative skills; turning and parking skills; city, highway, and freeway driving; driving laws; insurance; accidents and accident avoidance; emergencies; and car maintenance.

by S. D. Jaworski  
Cosmopolitan Driver Training School, 5124 W. Sunnyside Ave., Chicago, Ill. 60630  
1974 ; 233p  
Availability: Corporate author

HS-015 815

### **FACTORS ASSOCIATED WITH SAFETY BELT USE IN 1974 STARTER-INTERLOCK EQUIPPED CARS**

Interview data were obtained from 394 drivers whose safety belt use or non-use had been observed in 1974 cars equipped with a starter interlock system linked to belts and seat sensors. Belt use was not related to education, race, comfort-convenience ratings of belts, or having had a friend injured but not killed in a crash--factors that had been found related to belt use in previous research on earlier model cars not equipped with starter interlock systems. Drivers in 1974 cars

May 31, 1975

HS-015 820

were more likely to be seen using belts if they used their cars on their jobs or were in and out of them frequently, on average, each day. Despite favorable ratings of the efficacy of belt use, over 40% of drivers in 1974 cars were not using belts and 29% claimed that the interlock was among the least liked features of their new cars.

by L. S. Robertson  
Insurance Inst. for Highway Safety, Washington, D. C.  
1974 ; 14p 10refs  
Availability: Corporate author

HS-015 816

### HOW DRIVERS PREVENTED FROM DRIVING WOULD REACH WORK: IMPLICATIONS FOR PENALTIES

The validity of the assumption that loss of a driving license would result in economic hardship for most drivers was examined. Persons who drive to work were asked how they would reach work if a broken leg prevented them from driving. Only 21% said they would not be able to make other travel arrangements. Of those who thought they could find other transportation, two-thirds said the alternative would cost no more than driving themselves. Less than 20% said the time required would be more than an additional half hour per day. The results indicate that policies and practices related to license suspension and revocation should not be based on an assumption that job loss or economic hardship would be experienced by most drivers if they were to lose their driving privileges.

by S. P. Baker; L. S. Robertson  
Johns Hopkins School of Hygiene and Public Health, Dept. of Public Health Administration; Insurance Inst. for Hwy. Safety, Washington, D. C.  
1974 ; 15p 10refs  
Availability: Insurance Inst. for Hwy. Safety, 300 Watergate 600, Washington, D. C. 20037

HS-015 817

### FIRE IN MOTOR VEHICLE ACCIDENTS

An HSRI study is described which examined four aspects of fire in motor vehicle accidents: the number of such fires that occur annually, the number of fatalities accompanied by such fires, the number of fatalities resulting directly from such fires, and relationships between types of crashes, fuel leakage, fuel-fed fires, and associated fatalities. Three broad categories of data were investigated: seven previous research studies; four separate bodies of HSRI-held traffic accident and medical data; and five sets of mortality records maintained by various state or national fire protection or public health organizations. The study found that approximately 17,000 fires result from motor vehicle accidents annually, that from 720 to 1250 fatalities are accompanied by those fires, and that from 450 to 650 of those fire-associated fatalities result directly from the vehicle fires. The study also found that from 180 to 260 annual fatalities resulting from vehicle fires could be eliminated if all vehicles on U.S. roadways were to comply with the standards contained in the newly amended Motor Vehicle Safety Stan-

dard 301. This could be accomplished over approximately a ten-year period of new-model car introduction.

by P. Cooley  
Publ: HIT LAB REPORTS v5 n1 p1-20 (Sep 1974)  
1974 ; 31refs  
Based on HSRI Special Rept., "Fire in Motor Vehicle Accidents", dtd. Apr. 1974, publication no. UM-HSRI-SA-74-3, sponsored by the Motor Vehicle Mfrs. Assoc. See HS-014 838.  
Availability: See publication

HS-015 818

### ROAD SAFETY AND THE CONSUMER. A MAJOR NEW RESEARCH INITIATIVE

It is suggested that the sum total of accident sequels is one of the most serious, and largely unchecked, negative outputs of the road traffic system. The size and trend of the problem is discussed, with United Nations statistics cited. Different international definitions are noted to be a problem, and it is shown that action to prevent accidents or to lessen their sequels must consider all three factors involved: human (drivers and pedestrians), vehicles and their equipment, and the environment. Human factors are seen to be the key aspect of the problem. Action by international congresses on road traffic techniques and the formation of the International Drivers' Behavior Research Association are reviewed along with current research on such topics as high accident rate locations, risk taking, and driver attitudes and opinions.

by T. Benjamin  
Publ: INTERNATIONAL CONSUMER v15 n2 p7-12 (Summer 1974)  
1974 ; 10refs  
Availability: See publication

HS-015 820

### WHICH AUTOMOTIVE ENGINES IN THE FUTURE?

The range of expected marked penetration of future automobile engine designs is shown. In the near term, the stratified-charge engine is potentially attractive, offering required low emissions without sacrifice in fuel economy. It does not add costly hang-on controls of questionable reliability, and it represents a relatively minor tooling change. The catalytic converter is expected to have a short history due to cost, material imports, and regular inspection and maintenance. On a long-term basis, five candidates are mentioned: electric vehicles, hybrid (engine/electric) systems, the Stirling engine, diesel, and Warren engines. It is suggested that the Wankel, Rankine, or the gas turbine are not likely to become automotive power plants with impact by the year 2000. It is expected that the reciprocating piston engine will remain dominant at the turn of the century, although it may change from internal to external combustion, and use various energy recovery systems.

by B. Sternlicht  
Publ: MECHANICAL ENGINEERING v96 n11 p14-22 (Nov 1974)  
1974 ; 13refs  
Availability: See publication

HS-015 821

**A NEW WET CLUTCH FAN DRIVE SYSTEM**

A new concept is described for controlling fan speed with a wet, fully modulating slip clutch. The fan clutch operates in a feedback system. An increase or decrease in fan speed and resultant amount of cooling from the fan are reflected in the coolant temperature of the engine and the clutch regulator valve. The advantages of this fan drive system in vehicles are noise reduction, horsepower savings, fuel economy, increased belt life, reduced mechanical shock to the fan, and reduction of thermal shock to engines. The features of this fan drive system that contribute to those advantages make the system attractive to other unrelated applications.

by G. F. Cummings

Publ: MECHANICAL ENGINEERING v96 n11 p34-8 (Nov 1974)

1974

Based on a paper contributed by the ASME Design Engineering Div.

Availability: See publication

HS-015 822

**MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS. PT. 7: TRAFFIC CONTROLS FOR SCHOOL AREAS**

Uniform standards for traffic control in school areas of the U. S. are presented, based on formal court rulings that have been approved subsequent to the issuance of the manual. The manual is divided into six parts dealing with general rules, signs, markings, school area traffic signals, crossing supervision, and grade separated crossings. Consideration is given to the need for standards, school routes, engineering studies, legal authority, maintenance, removal of confusing advertising, bus stops, parking and stopping, crosswalks, curb markings, standardization, signalized intersections, pedestrian detectors, adult guards and student patrols.

Federal Hwy. Administration, Washington, D. C.

Rept. No. ANSI-D6.1-1971 ; 1971 ; 38p 9refs

Prepared in cooperation with the American Assoc. of State Hwy. Officials and the National Joint Com. on Uniform Traffic Control Devices.

Availability: GPO \$0.75

HS-015 823

**ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SURVEYS OF DRINKING-DRIVING BEHAVIOR: A REVIEW OF THE LITERATURE AND A RECOMMENDED METHODOLOGY**

In order to obtain information on the nature and extent of the drinking driver problem, and to provide a basis for international comparisons by uniform data gathering techniques, results of roadside sampling of the blood alcohol content of passing motorists were reviewed. Areas reporting were: Evanston, Illinois; the provinces of Alberta and New Brunswick (with a specific study of Edmonton-Calgary) and Toronto, Canada; Bratislava, Czechoslovakia; New York City; Grand Rapids and Washtenaw County, Michigan; Howard County, Indiana; France; Burlington, Vermont; Delhi, India; Netherlands; Norway; Canberra, Australia; Mecklenburg County, North Carolina; and Albuquerque-Bernalillo County, New

Mexico. International meetings held in London, England, Ottawa, Canada, and Paris, France, are covered. A comparison of 13 of the roadside surveys is tabulated. A research methodology is set forth, having breath as the biological specimen of choice, and including a questionnaire and recommendations for conducting future roadside surveys in such a manner as to yield results suitable for international comparison.

Road and Motor Vehicle Traffic Safety, Ministry of Transport, Canada

Rept. No. CTS-1b-74 ; 1977 ; 88p 18refs

Availability: Corporate author

HS-015 824

**DRINKING-DRIVING IN THE PROVINCE OF ONTARIO**

The overall trend in Ontario is shown to be an increase in alcohol use, with available information indicating that this trend is largely attributable to a growing acceptance of alcohol as a part of every day life and to a lack of public awareness of the damaging consequences of alcohol consumption. The problem is examined in terms of: drinking, driving, and collisions; alcohol-involved collisions in Ontario; drinking driving laws; traffic law enforcement; and the cost of drinking and driving. Intervention is discussed in terms of the government role, alternative types and timing of intervention, and countermeasure programs. Statistical data are included on: per capita sales and consumption of alcohol in Canada and other countries; Ontario alcoholic beverage sales and the revenue therefrom in relation to other revenue; Ontario motor vehicle permits, driver population by age, mileage travelled, 1972 and 1973 fatal, non-fatal, and property damage collisions with their alcohol involvement, and alcohol involved human damage collisions by month; Ontario alcohol-involved fatal and non-fatal collisions by day of week, by time of day, and by county; driver condition in fatal collisions and in all collisions 1967-73 in Ontario; collision-involved drinking drivers by age group; alcohol in fatally injured drivers; accuracy of police report on driver condition; and number of drivers charged, convicted, sentenced, or subject to penalties for alcohol involvement. A collision report form is included. It is concluded that the concurrence of drinking and driving may be prevented through appropriate government countermeasures; that government intervention into the problem would probably meet with broad public support; and that any attempt to reduce alcohol abuse generally would involve complete and far reaching measures which could only be introduced over a period of time. However, reduction of the drinking driver problem involves less complex measures, some of which could be introduced in the near future.

Inter-Ministerial Com. on Drinking and Driving, Ontario, Canada

1974 ; 119p 9refs

Prepared for the Provincial Secretary for Justice, Ont., Canada.

Availability: Provincial Secretary for Justice, Province of Ontario, Toronto, Ont., Canada



May 31, 1975

HS-015 829

HS-015 825

### **EMERGING OPPORTUNITIES FOR THE PEDESTRIAN ENVIRONMENT**

Alternatives for the pedestrian environment are examined and circumstances are defined along with motivations that may justify the provision for pedestrian environment within new or existing components of the city. Criteria for classification are offered, including: the pedestrian space created within the new development, versus the pedestrian space obtained by restructuring the existing urban context; the pedestrian environment as created by a mall, a public square, or a short street closed to traffic versus the pedestrian environment as a network for pedestrian circulation clearly distinguished from the circulation system for vehicles and services; and the pedestrian environment as a permanent component of the urban area, versus the pedestrian environment as a periodic, part-time assignment of public space to exclusive pedestrian use. The high activity pedestrian environment is described with examples cited from Milan, Rochester, Dubrovnik (Yugoslavia), and Rome. Piazzas and malls are shown. The recreational pedestrian environment such as parks is also illustrated, and the challenges of the future are considered.

by E. Contini

Publ: HS-014 096, PROCEEDINGS OF THE PEDESTRIAN/BICYCLE PLANNING AND DESIGN SEMINAR, 1972, Berkeley, 1973, p1-7  
1973

Availability: Bound in HS-014 096

HS-015 826

### **PEDESTRIAN CIRCULATION PLANNING: PRINCIPLES, PROCEDURES, PROTOTYPES**

The current interest in pedestrian circulation planning is attributed to: a growing awareness that cities are for people; that the quality and amount of person movement should take precedence over vehicular traffic flow; an increasing recognition of the economic advantages resulting from pedestrian interaction in major commercial developments; and a rising realization that suburbs have often overlooked pedestrian circulation requirements. Consideration is given to: planning parameters and approaches; travel characteristics; movement options, e.g., sidewalks, skywalks, malls, plazas, ramps, stairs, escalators, elevators, pedestrian assists, microsystems; methods such as traffic signal controls, pedestrian walk signals, pedestrian malls and bus-pedestrian malls; circulation concepts; and some microsystem concepts. Case studies are cited for Washington, D. C. and Seattle, along with some initial concepts for midtown Manhattan.

by H. S. Levinson

Publ: HS-014 096, PROCEEDINGS OF THE PEDESTRIAN/BICYCLE PLANNING AND DESIGN SEMINAR, 1972, Berkeley, 1973, p8-31  
1973 ; 4refs

Availability: Bound in HS-014 096

HS-015 827

### **NEED FOR A PLANNED PEDESTRIAN ENVIRONMENT: THE PHILADELPHIA EXPERIENCE**

Pedestrian movement in the central business district of Philadelphia is examined in terms of problems, roadway characteristics, aesthetics (graffiti, etc.), and perceived safety. Television monitoring is being introduced. Methodologies for analysis are described, including railroad and subway concourses and development projects such as the proposed Market St. East Development. It is concluded that the use of existing, available pedestrian concourse areas provides ample opportunity for cost effective investment by the municipalities that can only benefit the community at large.

by I. N. Pierce

Publ: HS-014 096, PROCEEDINGS OF THE PEDESTRIAN/BICYCLE PLANNING AND DESIGN SEMINAR, 1972, Berkeley, 1973, p32-7  
1973 ; 1ref

Availability: Bound in HS-014 096

HS-015 828

### **PEDESTRIANS IN DOWNTOWN: OBSERVING PEOPLE IN THE BUILT ENVIRONMENT**

The interrelationships of physical space in downtown areas, patterns of user behavior, and people's attitudes are examined in an empirical type study. Four general situations of behavioral actions within defined physical environments were studied: the pedestrian cores of the Seattle central business district during the winter and the summer, the pedestrian core of the Portland, Oregon, central business district, and a planned regional shopping center in Seattle. The principal research procedures included inventories of visual form, interviews of users, and non-interactive observation. The main finding was that the built environment implicitly minimizes or ignores the needs of the pedestrian and is in effect hostile to the pedestrian. It is shown that public convenience and general environmental efficiency could be substantially increased by analysis of local waiting provisions and needs; i.e., mini parks. Malls and public spaces are not always desirable. Downtown is predominantly composed of discoverable user subsystems which should be considered in planning, scheduling, and designing future development. The actions and attitudes of the everyday user of downtown are also a largely untapped source of ideas.

by A. L. Grey; D. L. Bonsteel

Publ: HS-014 096, PROCEEDINGS OF THE PEDESTRIAN/BICYCLE PLANNING AND DESIGN SEMINAR, 1972, Berkeley, 1973, p38-42  
1973 ; 2refs

Availability: Bound in HS-014 096

HS-015 829

### **THE ENVIRONMENTAL QUALITY OF CITY STREETS: THE RESIDENTS' VIEWPOINT**

A small-scale attempt is made to identify the environmental concerns of those who live on the streets of San Francisco. The pilot study used observation and open response interview techniques, and does not pretend to statistical significance. The results, however, are suggestive. Consideration was given



to traffic flow and characteristics, population, environment, traffic hazards, stress, noise and pollution, social interaction, privacy and home territory, and environmental awareness. It was found that: the intensive traffic conditions on streets inhabited mostly by single persons of all ages and many elderly women led to both stress and withdrawal; people living on predominantly family populated streets were involved in their immediate areas; average streets were becoming major traffic corridors, making residents unhappy. The appearance of environmental quality was quite different from the environmental quality as revealed by the comments of residents. The pattern of interview responses suggested that the issues of safety, stress, condition, pollution, privacy, and territoriality, followed closely by neighborliness, were of primary concern to the inhabitants of all streets. The general trend was toward increased traffic on each of the three streets with the prospect that the environment of the streets would decline further. More extensive surveys are needed to assess the numbers of people who actually live under the deteriorated environmental conditions of streets with heavy traffic.

by D. Appleyard; M. Lintell  
 Publ: HS-014 096, PROCEEDINGS OF THE  
 PEDESTRIAN/BICYCLE PLANNING AND DESIGN  
 SEMINAR, 1972, Berkeley, 1973, p43-64  
 1973 ; 20refs  
 Sponsored by the San Francisco Dept. of City Planning and  
 the U. S. Dept. of Housing and Urban Devel.  
 Availability: Bound in HS-014 096

## HS-801 308

# VEHICLE BRAKING SYSTEMS TEST PROCEDURE-- HYDRAULIC BRAKES. FINAL REPORT

A brake testing program is aimed at refining the test procedures and test conditions specified in FMVSS 105a and at determining the degree to which current production commercial vehicles comply with the 1976 model year requirements. Seven vehicles ranging from a 1973 Chevelle Station Wagon (GVWR: 5160 lbs) to a 1974 Ford LT-800 truck (GVWR: 37,000 lbs), all equipped with a split hydraulic braking system, were tested. In general, the heavier vehicles had more difficulty meeting the 105a effectiveness requirements than the lighter vehicles. Performance on fade and recovery tests was similar for all vehicles.

by R. C. Boyer; R. L. Anderson; E. Enserink  
 Ultrasystems, Inc., Dynamic Science Div., 1850 West Pinnacle  
 Peak Road, Phoenix, Ariz. 85027  
 Contract DOT-HS-046-3-769  
 1974 ; 270p  
 Report for Jun 1973 - Jun 1974.  
 Availability: NTIS

## HS-801 315

# UNIFORM TIRE QUALITY GRADING TREADWEAR. FINAL REPORT

A conventional tread stock is compared with a lesser wearing tread stock for uniform tire quality grading (UTQG) treadwear testing. The tires used were General two (2) ply Rayon Skid Test Standards. The control group was branded series 18335.001 and featured tread stock with 75 parts N-242 (ISAF-HS) carbon black. The experimental group was branded series 18335.007 and featured tread stock with 70 parts HAF carbon black. Vehicles used were two identical 1973 Dodge Monacos,

tested on state and interstate highways. The 18335.001 group and the 18335.007 group ended the test 80% and 81% worn, respectively, yielding a wear rating of 99 for the 18335.007 group.

by K. D. Rodeheaver; C. W. Cole  
 Virginia International Testing Labs., Inc., 1548 Springhill Rd.,  
 McLean, Va. 22101  
 Contract DOT-HS-4-00799  
 1974 ; 11p  
 Availability: NTIS

## HS-801 318

# DEVELOPMENT AND EVALUATION OF A STRUCTURAL CRASHWORTHINESS SYSTEM FOR A STANDARD SIZE AUTOMOBILE. EXECUTIVE SUMMARY. FINAL REPORT

A study to develop two pre-prototype vehicles which would provide improved structural performance during front, side, rear and rollover collisions is described. This study was undertaken at three distinct developmental levels: development and evaluation related to subsystems, the structural system, and two pre-prototype vehicles. Subsystems investigated included the frame, passenger compartment structure, door beams, glass and padding. Both static and dynamic component test facilities were used. Review of the results provided a rational basis for integration of individual components into the final system. Complete system evaluation was made with five crash tests performed with important elements of the total system incorporated into a series of non-operational vehicles. Structural modifications were incorporated into two 1973 standard size sedans which were subjected to handling and crash testing. The vehicle performance generally met the requirements of the contract. Excellent performance was obtained during lateral collisions, where dummy results were within accepted limits during 30 mph moving barrier collisions. The total structural modification resulted in a net weight increase slightly less than 10% of the base vehicle (1973 Ford) curb weight.

by P. M. Miller; J. E. Greene  
 Calspan Corp., 4455 Genesee St., Buffalo, N. Y. 14221  
 Contract DOT-HS-053-2-487; Ref: FH-11-6918; Ref: FH-11-7622  
 Rept. No. ZM-5177-V-3 ; 1975 ; 31p 1ref  
 Report for Jun 1972 - Jun 1974.  
 Availability: NTIS

## HS-801 323

# THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 1.SUMMARY REPORT. FINAL REPORT

The overall objectives of this research program were to identify the properties of tires that affect vehicle dynamic response and to describe those effects in quantitative terms; and to evaluate the degree to which the various tire parameters affect vehicle dynamic response and to assess their relative importance. The study involved: a laboratory tire test program to measure the performance parameters of interest (braking and lateral force coefficients, aligning and overturning moments, etc.) on selected tires with specified construction properties; a vehicle test program in which the effects of tires with different properties and parameters were measured on four cars using

nine wet and dry test maneuvers; and a fundamental vehicle simulation study designed to determine the effect of individual tire parameters on various vehicle performance metrics. The technical approach of the program is summarized, and conclusions are presented with regard to tire wear-in, vehicle-tire braking performance, mixed tires, and rulemaking relating to vehicle-tire combinations.

by R. D. Roland; R. S. Rice; F. Dell'Amico  
Calspan Corp., 4455 Genesee St., Buffalo, N. Y. 14221  
Contract DOT-HS-053-3-727  
Rept. No. ZM-5350-K-1 ; 1975 ; 37p 6refs  
Report for 30 Jun 1973 - 30 Jun 1974. See also HS-801 324, Vol. 2  
Availability: NTIS

HS-801 324

### **THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 2. TECHNICAL REPORT. FINAL REPORT**

Objectives of the program of research into the influence of tire properties on passenger vehicle handling were to determine the quantitative relationship between tire construction properties and their performance parameters; to investigate the influence of tire properties, as identified primarily by their performance parameters; and, through correlation of results of those two objectives, to make the tie-in between passenger car handling and tires as identified by their construction features. A thorough technical discussion is given of the program with the necessary background information and methodology used in tire testing, full scale testing, and computer simulation. Overall conclusion is made that tire test results have shown that cornering stiffness and peak braking force coefficient are dependent on several tire construction properties. The fullscale test and the simulation results have shown that tire effects were more significant in steering than in braking maneuvers. Differences in the basic vehicle response characteristics as measured in these tests and which can be attributed to differences in tire performance factors are detectable in most cases, but they are often smaller than the differences among the tire factors.

by R. D. Roland; R. S. Rice; F. Dell'Amico  
Calspan Corp., Buffalo, N. Y.  
Contract DOT-HS-053-3-727  
Rept. No. ZM-5350-K-2 ; 1975 ; 177p 5refs  
Report for 30 Jun 1973 - 30 Jun 1974. See also HS-801 323, Vol. 1.  
Availability: NTIS

HS-801 334

### **TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS. VOL. 1--RESEARCH FINDINGS. FINAL REPORT**

Data were collected on three levels of detail for the final report of the first year of activity under a proposed three-year program on traffic accident causes. Police reports and other baseline data on the Monroe County, Indiana study area were collected on Level A. On Level B, teams of technicians responded to accidents at the time of their occurrence to conduct on-scene investigations. On Level C, a sample of 22% of these accidents were independently examined by a multidisciplinary team. A general population survey was also con-

ducted. The report is presented in nine major sections: introduction; methodology overview; findings regarding accident causes; accident and control sample comparisons; cluster analysis; problem driver identification; analysis of study sample representatives; conclusions; and recommendations. The findings regarding accident causes are examined in terms of human factors, environmental factors, vehicle factors, analysis of accident severity as a function of causal factors, and analysis of model year distribution of vehicles having deficiencies which caused accidents.

Inst. for Research in Public Safety, Indiana Univ., 400 East Seventh St., Bloomington, Ind. 47401  
Contract DOT-HS-034-3-535  
Rept. No. IRPS-DOT-HS-034-3-535-73-TAC ; 1975 ; 250p 22refs  
Report for 15 Aug 1972 - 14 Aug 1973.  
Availability: NTIS

HS-801 335

### **TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS: INTERIM REPORT I. VOL. 2--APPENDICES.**

Appendices are presented in conjunction with the Monroe County, Indiana tri-level study of the causes of traffic accidents. The appendices deal with: pre-crash, tri-level methodology for collision data generation; on-site data collection forms; in-depth data collection forms; Phase 2 and Phase 3 causal result detailed data tables; baseline sampling instruments; accident/control sample comparisons and involvement ratio plots; and cluster analysis.

Inst. for Research in Public Safety, Indiana Univ., 400 East Seventh St., Bloomington, Ind. 47401  
Contract DOT-HS-034-3-535  
Rept. No. IRPS-DOT-HS-034-3-535-73-TAC ; 1975 ; 420p 14refs  
Report for 15 Aug 1972 - 14 Aug 1973.  
Availability: NTIS

HS-801 344

### **IDENTIFICATION OF COUNTERMEASURES FOR THE YOUTH CRASH PROBLEM RELATED TO ALCOHOL. FINAL REPORT**

Face-to-face interviews were conducted with male New York State drivers. These groups, each containing young (16-24 years) and middle aged (35-49 years) drivers were sampled as follows: random sample of the general population of licensed drivers; drivers recently involved in an 8 p.m. to 6 a.m. injury producing motor vehicle crash; and drivers recently convicted on an alcohol driving offense. The results indicated that 14% of the young drivers in the general population as compared with only 5% of the middle aged drivers reported having had an alcohol-related accident within the past three years. Alcohol-related crashes for young drivers as compared to non-alcohol-related crashes tended to more often involve greater vehicle speeds prior to the crash, and the use of drugs other than alcohol, as well as being late night single vehicle events. Driving after drinking was common among young people (about three times per month) and drinking frequency appeared consistent across both young and middle aged driver populations. Young people, especially young people involved in an alcohol-related driving event, more often perceived the

HS-801 345

drinking driver as a brave, independent, popular individual. Young driver alcohol crash countermeasure and future research recommendations are made in the areas of driving restrictions, speeding statutes, public information, and rehabilitation.

by D. F. Preusser; J. F. Oates, Jr.; M. S. Orban  
Dunlap and Associates, Inc., Darien, Con..  
Contract DOT-HS-099-3-747  
Rept. No. ED-74-12 ; 1975 ; 240p 64refs  
Report for Jun 1973 - Sep 1974.  
Availability: NTIS

HS-801 345

#### **DWI LAW ENFORCEMENT TRAINING PROJECT. EVALUATION AIDS PACKET AND MEDIA LOG**

An evaluation aid packet is presented to inform regions, states, and communities of an institute to train instructors by familiarization and practice with the new Driving While Intoxicated (DWI) Law Enforcement training program. The evaluation packet contains forms used in student and course evaluation. The student evaluation involves pre- and posttest items, student response cards, and controlled drinking exercise. Details on instructional aids are given for the nature and use of the film log, video tape recording log, and transparencies. When implemented nationally by the National Highway Traffic Safety Administration (NHTSA), the DWI Law Enforcement Training program should improve the alcohol enforcement activities of law enforcement officers.

by J. E. Carnahan; C. L. Dreveskracht  
Michigan State Univ., East Lansing. Highway Traf. Safety  
Center  
Contract DOT-HS-334-3-645  
1974 ; 184p  
Availability: NHTSA

HS-801 349

#### **HIGHWAY SAFETY PROGRAM MANUAL. VOL. 7. TRAFFIC COURTS**

Designed as a guide for states and their political subdivisions to use in developing highway safety program policies and procedures, this seventh volume in a series of 18 deals with the development of an effective traffic court system and efficient reporting of convictions for moving traffic violations. Specific objectives and program recommendations are set forth as conditions of judicial administration which the state should consider in the review, analysis, and evaluation of its traffic court system. Program elements include aspects of required appearances in court, financial independence of the traffic courts from revenues produced from processing violations, expanded availability of court services, business administration, uniform rules governing court procedure, and development and distribution of manuals and guides for court administration, procedures, and accounting. Major consideration is given to court authority, general policy, program development and operations, program evaluation, reports, and local government participation. Appendices provide details on representative projects and resource organizations which assist in achieving the purpose of the standard.

National Hwy. Traf. Safety Administration, Washington, D. C.  
1974 ; 43p 10refs  
Availability: GPO \$1.50

HSL 75-5

HS-801 352

#### **BRAKING EFFICIENCY TEST TECHNIQUE. FINAL REPORT**

A braking efficiency test technique is described which provides a method whereby vehicle stopping performance can be specified, measured, and compared independently of the test surface. The method provides for an independent measure of the prevailing friction potential of the test surface. This measure is used to normalize the measured stopping performance of the test vehicle. The concept presented is tailored toward a safety argument and toward rulemaking as a potential adaptation to braking effectiveness requirements which currently exist. A new mobile tire dynamometer, developed for this program, is discussed, as are the results of a demonstration test program carried out at the Bendix Automotive Development Center.

by R. D. Ervin; C. B. Winkler  
Hwy Safety Res. Inst., Univ. of Michigan, Huron Pkway. &  
Baxter Rd., Ann Arbor, Mich. 48105  
Contract DOT-HS-031-3-765  
Rept. No. UM-HSRI-PF-74-13-1 ; 1974 ; 219p 123refs  
Report for Jul 1973 - Nov 1974.  
Availability: NTIS

HS-801 353

#### **BRAKING EFFICIENCY TEST TECHNIQUE. SUMMARY REPORT**

A braking performance characterization having been developed by which the influence of pavement friction becomes normalized to render a measure which is argued to be inherently relevant to traffic safety, conclusions are that braking efficiency technique is capable in concept of accounting for the prevailing frictional constraints which limit a vehicle's braking performance on any paved surface. The developed concept is such that it is comprehensively applicable to vehicles operated in the United States but is not international because of the difference in weight and size of foreign vehicles. The braking efficiency method itself is totally objective since stopping distance performance is evaluated through an open-loop test procedure which is constrained through objective descriptions of initial velocity, wheel lockup, pedal application, and distance measurement, and the normalizing numeric is derived through a mechanistic process of data gathering and processing. On the basis of developments made during this study, recommendations are made for a program of braking efficiency measurements, a survey of peak traction measurements, measurements of the shear force potential of a variety of paved surfaces, and further refinement of braking efficiency methods.

by R. D. Ervin; C. B. Winkler  
Hwy. Safety Res. Inst., Univ. of Michigan, Huron Pkwy. &  
Baxter Rd., Ann Arbor, Mich. 48105  
Contract DOT-HS-031-3-765  
Rept. No. UM-HSRI-PF-74-13-2 ; 1974 ; 34p  
Report for Jul 1973 - Nov 1974.  
Availability: NTIS

HS-801 361

**SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, SEPTEMBER 1974**

Status of the subcompact car crashworthiness program is reviewed, including the development plan of work and methodology. Baseline tests are described along with the mathematical model used as a basis to improve structures, and the development of structurally improved vehicles. A fabrication design and schedule are reviewed, with personnel problems cited. Fabrication modifications are noted. Two test vehicles, a 1968 Plymouth and a modified 1974 Pinto, were prepared and crash tested. Details are given on a 30-mph oblique side impact with the Plymouth impacting the side-modified Pinto at 300 degrees. Post test inspection of the vehicles showed less damage than was anticipated. The maximum compartment intrusion of 4.5 inches was well below the intrusion experience in a 270 degree front-to-side impact. Vehicle acceleration levels were reasonable. In summary, the vehicle performed adequately for this side impact primarily due to good bumper-rocker panel contact. The driver (dummy) did not survive due to a head strike into the side window.

by R. B. Tanner  
Minicars, Inc., 35 La Patera Lane, Goleta, Calif.  
Contract DOT-HS-113-3-746  
1974 ; 268p  
Availability: NHTSA

HS-801 362

**FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, SEPTEMBER 1974**

The status of a feasibility study of plastic automotive structure is reviewed. The research objective is to improve vehicle crashworthiness characteristics while decreasing weight in comparison to conventional metallic structure. The program consists of four parts: A state-of-the-art survey to determine present and experimental applications of plastic materials; research and development to investigate materials, design configurations, and analytical techniques to provide structures satisfying the requirements of vehicle function and crashworthiness at reduced weight; selected frontal design for a subcompact size automobile; evaluation of practical problems associated with production feasibility, cost, and other pertinent problems which will affect the utilization of plastics in automotive structures.

by H. A. Jahnle  
Budd Co., Technical Center, 300 Commerce Dr., Ft. Washington, Pa.  
Contract DOT-HS-4-00929  
1974 ; 89p 20refs  
Availability: NHTSA

HS-801 363

**FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, JUNE-JULY 1974**

The feasibility is examined of employing plastic materials in the fabrication of vehicle structure for the purpose of improving crashworthiness characteristics and decreasing weight in comparison to conventional metallic structures. The plan of work and methodology is detailed along with a state-of-the-art

survey regarding materials, structural design characteristics, and energy absorption and management. The problems of toxicity and flammability are noted.

by H. A. Jahnle  
Budd Co., Technical Center, 300 Commerce Dr., Ft. Washington, Pa.  
Contract DOT-HS-4-00929  
1974 ; 14p  
Availability: NHTSA

HS-801 364

**PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT (21ST), 1 MARCH TO 31 MARCH 1974**

A series of completed static bumper tests and low speed bumper tests is described, using the first pre-prototype vehicle equipped with the pneumatic low speed bumper system. A second pre-prototype vehicle available for preliminary inspection is also discussed. Photographs and graphs of the bumper tests are included. No problem areas are cited.

by J. M. Horowitz  
Calspan Corp., Buffalo, N. Y. 14221  
Contract DOT-HS-053-2-487  
Rept. No. ZM-5177-M ; 1974 ; 13p  
Availability: NHTSA

HS-801 365

**COMPOSITE MATERIALS IN AUTOMOBILE SIDE STRUCTURES--FEASIBILITY EVALUATION. MONTHLY LETTER REPORT NO. 13, JUNE 1974**

The status of a feasibility study regarding the use of composite materials in automotive vehicle side structures so as to improve the crashworthiness of the vehicle when impacted in the side is described. The fabrication, dynamic testing, and analysis of sub-elements of each of the composite material vehicle design concepts has been completed. Conceptual design concept "A", identified as the wedge concept, has proven to be superior. The fabrication and installation of composite materials in the side structures of the test vehicles is proceeding rapidly. Graphs and photographs are presented to illustrate the results of dynamic drop weight impact tests as well as the door and side structure fabrication.

by W. H. Smith  
IIT Research Inst., 10 West 35 St., Chicago, Ill. 60616  
Contract DOT-HS-105-3-680  
Rept. No. D6080-13 ; 1974 ; 14p  
Report for 31 May - 30 Jun 1974.  
Availability: NHTSA

HS-801 367

**SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, AUGUST 1974**

The status of a subcompact car crashworthiness program is reviewed in terms of work plan and methodology, baseline tests, and structural development. Structural modifications are described for a Plymouth and Pinto to be tested in frontal off-

HS-801 368

set impact. It is shown that volumetric structures can be designed for the full range of impact conditions.

by R. B. Tanner  
Minicars, Inc., 35 La Patera Lane, Goleta, Calif. 93017  
Contract DOT-HS-113-3-746  
1974 ; 75p 5refs  
Availability: NHTSA

HS-801 368

#### **SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, JULY 1974**

The status of a subcompact car crashworthiness program is reviewed in terms of work plan and methodology, baseline tests, mathematical models, and structural development. The baseline testing is analyzed for the Plymouth and Pinto test vehicles. Crush data are presented, along with fabrication and installation of the modified design, evaluation tests, and data analysis. In front-to-side impacts the maximum crush measured along the left side of the vehicle was 45.5 inches, with the passenger compartment maintaining its integrity. Plans for future work are noted.

by R. B. Tanner  
Minicars, Inc., 35 La Patera Lane, Goleta, Calif. 93017  
Contract DOT-HS-113-3-746  
1974 ; 19p  
Availability: NHTSA

HS-801 369

#### **INFLATABLE BELT DEVELOPMENT FOR SUBCOMPACT CAR PASSENGERS. PROGRESS REPORT, SEPTEMBER 1974**

Preparation of the first hardware for static inflator testing in subcompact automobiles is described, along with plans for conducting computer simulations to finalize the force-stroke characteristics of the airbelt force limiter. The actual work plan is detailed. Design parameters which have been derived by computer simulation are discussed, and consideration is given to how these parameters will be used in configuring the baseline system for sled testing. It is shown that a System 1 design appears to protect the 50th percentile in the mid and rear passenger seat positions without exceeding injury limits currently established. A two-point system could be made passive more easily than the three-point system.

by M. Fitzpatrick  
Minicars, Inc., 35 La Patera Lane, Goleta, Calif. 93017  
Contract DOT-HS-4-00917  
1974 ; 23p 1ref  
Availability: NHTSA

HS-801 370

#### **FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, DECEMBER 1974**

Test data, literature and suggestions from the Contract Technical Manager obtained in this study to date were reviewed during December to evaluate the feasibility of plastic, crashworthy automotive structures. This evaluation is summarized and a frontal structure concept is developed. In the future,

HSL 75-5

dynamic testing of foam-filled tubular elements, 36 inches long, at higher energy levels will be continued. Curved foam-filled elements will be fabricated and tested in static and dynamic compression. Alternate frontal design concepts to the tubular concept will be examined, and dynamic analysis will continue.

by H. A. Jahnle  
Budd Co., 300 Commerce Dr., Ft. Washington, Pa. 19034  
Contract DOT-HS-4-00929  
1974 ; 14p  
Availability: NHTSA

HS-801 371

#### **FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, NOVEMBER 1974**

Preliminary data indicating that glass reinforced polyesters absorbed energy at force levels of interest is considered insufficient to be of much value to this program. While data concerning energy requirements to manufacture structures from steel, aluminum and plastics materials is not complete, it does appear that steel requires less energy than plastics on a per pound basis but due to the low density of plastic materials they are superior to steel on a volume basis. Crush tests and dynamic compression tests were made at a crushing rate of 2 inches per minute and at 20 and 30 mph impact velocities. Work to be done in 2 phases was started on the dynamic analysis of plastic frontal structure during a crash condition. Test specimens will be dynamically compressed to determine if material is impact velocity or energy sensitive. This will be done by impacting specimens at the same kinetic level but at two impact velocities. Specimens will be tested at greater wall thicknesses to further confirm the benefits in both crush resistance and crush resistance per unit weight. Dynamic crush tests will be made on nominally 2 1/2 and 3 inch diameter foam filled cylinders.

by H. A. Jahnle  
Budd Co., 300 Commerce Dr., Ft. Washington, Pa. 19034  
Contract DOT-HS-4-00929  
1974 ; 23p 2refs  
Availability: NHTSA

HS-801 372

#### **FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, AUGUST 1974**

The feasibility is examined of employing plastic materials in the fabrication of vehicle structures for the purpose of improving crashworthiness characteristics and decreasing weight in comparison to conventional metallic structures. The plan of work and methodology is outlined. Attention is focused on a state-of-the-art survey, with regard to materials (thermoset, skinned foams, and non-skinned foams), structural design characteristics, energy absorption and management, and integration of plastics into the automotive structure. Problems of flammability and toxicity are described.

by H. A. Jahnle  
Budd Co., 300 Commerce Dr., Ft. Washington, Pa. 19034  
Contract DOT-HS-4-00929  
1974 ; 10p  
Availability: NHTSA

HS-801 373

**COMPOSITE MATERIALS IN AUTOMOBILE SIDE STRUCTURES--FEASIBILITY EVALUATION. MONTHLY LETTER REPORT NO. 14, JULY 1974**

The feasibility is examined of using composite materials in automotive vehicular side structures in order to improve vehicle crashworthiness when it is impacted in the side of the passenger compartment. The fabrication and installation of all vehicular composite material side structures was completed, and a plan was developed for conducting three vehicle/vehicle impact tests. Wedge type non-metallic composite material structures were installed in the doors of target vehicles. Materials included low-density polyurethane foam, honeycomb, and polyester foam. Particular emphasis was given to the improvement of vehicle crashworthiness, weight reductions, production feasibility, and body maintainability. Test vehicle instrumentation is also described, and photographs are presented.

by W. H. Smith  
IIT Research Inst., 10 West 35 St., Chicago, Ill. 60616  
Contract DOT-HS-105-3-680  
Rept. No. D6080-14 ; 1974 ; 17p  
Report for 30 Jun - 31 Jul 1974.  
Availability: NHTSA

HS-801 374

**SOURCES AND REMEDIES FOR RESTRAINT SYSTEM DISCOMFORT AND INCONVENIENCES. FINAL BRIEFING**

Restraint system design features that appear to create confusion, inconvenience, and discomfort for driver and passengers are identified and evaluated. The scope of the study is limited to seat belt/shoulder harness systems, with emphasis on the 1974 restraint systems. Potential systems under development, such as the passive belt (non-air bag) are also considered. Photographs and charts are included. A single, practical optimum design and installation configuration is identified and developed which fits the desired user population.

by B. F. Pierce  
Man Factors, Inc., San Diego, Calif.  
Contract DOT-HS-230-3-674  
1974 ; 28p  
Availability: NHTSA

HS-801 375

**INJURY ASSESSMENT OF BELTED CADAVERS. PROGRESS REPORT NO. 4, OCTOBER 1974**

Data are presented describing the status of injury research on belted cadavers. The first test involved a deceased, 58-year-old male with a test weight of 216 pounds and a standing height of 6 feet, 1 inch. Total sled velocity change was 29.1 mph, and the maximum sled deceleration during impact was 20.5 g. The sled velocity change and sled acceleration are plotted and displayed. Injuries were sustained in three areas: spinal cord, chest cage, and colon. All injuries were subjacent to and probably secondary to the restraining action of the seat belts

used. The combination of all injuries to all body parts would provide an accident injury score (AIS) code of 8.

by J. R. Cromack  
Southwest Res. Inst., 8500 Culebra Rd., P.O. Drawer 28510, San Antonio, Tex. 78284, Dept. of Automotive Res.  
Contract DOT-HS-4-00998  
Rept. No. SWRI-11-4019 ; 1974 ; 32p  
Report for 1 Oct - 31 Oct 1974.  
Availability: NHTSA

HS-801 376

**INJURY ASSESSMENT OF BELTED CADAVERS. PROGRESS REPORT NO. 3, SEPTEMBER 1974**

The research status of the belted cadaver tests is reviewed. Problems regarding shipment of and use of unembalmed cadavers in Texas are noted along with specific techniques developed to study impact effects on the body. Personnel requirements for the contract are reviewed.

by J. R. Cromack  
Southwest Res. Inst., 8500 Culebra Rd., P.O. Drawer 28510, San Antonio, Tex. 78284, Dept. of Automotive Res.  
Contract DOT-HS-4-00998  
Rept. No. SWRI-11-4019 ; 1974 ; 5p  
Report for 1 Sep - 30 Sep 1974.  
Availability: NHTSA

HS-801 377

**SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, NOVEMBER 1974**

The status of the subcompact car crashworthiness program is reviewed in terms of work plan and methodology, baseline tests, structural development, and data analysis. A 50 mph frontal barrier test was conducted using a modified 1974 Pinto two-door sedan with optional 2.3 litre engine and four-speed transmission. Instrumentation and test site preparation are detailed. The test results are given with regard to exterior structural damage (total static crush of 35.2 inches including a large portion of the plenum chamber), passenger compartment intrusion (0.5 and 0.9 inches), physical data, instrumentation data, and photographic data. Photographs and graphs are included.

by D. Friedman  
Minicars, Inc., 35 La Patera, Goleta, Calif. 93017  
Contract DOT-HS-113-3-746  
1974 ; 27p  
Availability: NHTSA

HS-801 378

**PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT NO. 22, APRIL 1974**

The production feasibility is examined of a full-size automobile which incorporates front, side, and rear modifications developed in previous research. Completion of all tests involving the first pre-prototype vehicle was accomplished during this reporting period. These consisted of handling tests, a high speed frontal flat barrier impact test, and a high speed moving barrier rear impact test. A second pre-prototype vehicle was

also completed and delivered which is currently being prepared for a side moving barrier impact test and subsequent high speed 30 deg frontal barrier impact test. Test results and future work are described.

by J. M. Horowitz  
Calspan Corp., Buffalo, N. Y. 14221  
Contract DOT-HS-053-2-487  
Rept. No. ZM-5177-V ; 1974 ; 5p  
Report for 1 Apr - 30 Apr 1974.  
Availability: NHTSA

HS-801 384

# **FABRICATION OF A STANDARD BENCH VEHICLE SEAT. FINAL REPORT**

The development of a standard bench seat for the testing of child restraint systems based on the configuration and performance parameters of the 1974 Chevrolet Impala production bench seat is discussed. Both static and dynamic characteristics of the production seat were modeled into the frame deformation and foam stiffness of the standard seat, and impact sled tests were conducted on each using a representative sample of child restraint systems to provide direct comparison between the two seats. The standard seat was shown to be a durable, repeatable test platform for child restraints that provided reasonable simulation of the production seat. Its economic breakeven point occurs when more than four new production bench seats are required for testing. Child restraint tests on the standard seat tend to give slightly lower head and chest peak resultant acceleration, HIC and severity index values, and, in some cases, larger head excursion values than comparable tests with the production seat.

by R. L. Stalnaker; J. B. Benson; J. W. Melvin  
Hwy. Safety Res. Inst., Univ. of Michigan, Ann Arbor 48105  
Contract DOT-HS-4-00865  
Rept. No. UM-HSRI-BI-74-5 ; 1974 ; 59p  
Report for 5 Mar 1974 - 14 Sep 1974. See also HS-801 385; HS-801 386.  
Availability: NTIS

HS-801 385

# **DATA FROM FABRICATION OF A STANDARD BENCH VEHICLE SEAT. APPENDIX C**

Specifications, photographs, and graphs are presented regarding fabrication of a standard bench vehicle seat for child restraint systems testing. Both static and dynamic characteristics of the production seat were modeled into the frame deformation and foam stiffness of the standard seat, and impact sled tests were conducted on each using a representative sample of child restraint systems.

Hwy. Safety Res. Inst., Univ. of Michigan, Ann Arbor 48105  
Contract DOT-HS-4-00865  
1974 ; 147p

See also HS-801 384; HS-801 386.

Availability: NTIS

HS-801 386

# **BELT RETRACTOR TESTING WITH STANDARD VEHICLE SEAT. APPENDIX D. MODIFICATION 1.**

Safety problems with various 1974 belt systems and child restraints during crash conditions were investigated, and the acceptability of use of such systems with the DOT Standard Vehicle Seat versus the General Motors Production seats was verified. Data were collected on differences between using non-retractor belts and retractor belt systems used in current production automobiles, and the effects of various sled pulses on retractor, vehicle seat, and child restraint performance was studied. The various belt systems were mounted in locations similar to actual vehicle positions. Test data are presented in columnar form, including child seat manufacturer and model, impact direction, retractor type, dummy age and seating position, sled parameters, head and chest accelerations, belt loads, and head excursion data. Dynamic restraint characteristics of the various belt systems are discussed.

Hwy. Safety Res. Inst., Univ. of Michigan, Ann Arbor 48105  
Contract DOT-HS-4-00865  
1974 ; 205p  
See also HS-801 384; HS-801 386  
Availability: NTIS

HS-820 262

# **A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY PREPARED ON RULES OF THE ROAD UNIFORMITY IN THE TRAFFIC LAWS OF THE SEVERAL STATES**

An overview of the degree and nature of uniformity from State to State in those traffic laws commonly known as Rules of the Road is presented. The Uniform Vehicle Code (UVC) and the Rules of the Road Rated studies prepared by the National Committee on Uniform Traffic Laws and Ordinances provide the bases for this overview. Congressional concern as to nonuniformity in State traffic laws is noted and the requirements of the current Codes and Laws highway safety program standard are stressed. The 1968 and 1971 Rules of the Road Rated Commentary tables, including the rankings of the States and their total scores of conformance with the UVC, are presented. Comparisons are made in the form of charts which illustrate State and regional progress during the three-year period in the context of 13 statutory areas. A summary is given along with comments on the need for statutory evaluations and a grading scheme for identifying traffic law deficiencies so that a sound basis obtains for making timely improvements in each State's body of traffic law.

by W. J. Norbet  
National Hwy. Traf. Safety Administration, Washington, D. C.  
1973 ; 111p refs  
Availability: NHTSA

## INDEX to ABSTRACTS



## KWOC Title Index

### ABSORBERS

SHOCK ABSORBERS FOR YOUR CAR. PT. 2:  
DYNAMOMETER, TRACK AND ROAD TESTS OF 10  
SHOCKS ON A CORVETTE

HS-015 749

### ABSORBING

ANGLE AND SMALL-CAR IMPACT TESTS OF AN AR-  
TICULATED GORE BARRIER EMPLOYING  
LIGHTWEIGHT CONCRETE ENERGY-ABSORBING  
CARTRIDGES

HS-015 792

DEVELOPMENT OF ENERGY ABSORBING AUTOMO-  
TIVE STRUCTURES USING SCALE MODEL TEST  
TECHNIQUES

HS-015 676

DEVELOPMENT OF ENERGY-ABSORBING SAFETY  
BELT WEBBING

HS-015 687

TESTS FOR HAZARDOUS FAILURE OF ENERGY AB-  
SORBING AUTOMOTIVE BUMPER CYLINDERS. RE-  
PORT

HS-015 802

### ABSTRACT

AN EVALUATION OF CALIFORNIA'S "GOOD  
DRIVER" INCENTIVE PROGRAM. ABSTRACT

HS-015 780

### ACCURACY

SCALE MODELING OF VEHICLE CRASHES--  
TECHNIQUES, APPLICABILITY, AND ACCURACY;  
COST EFFECTIVENESS

HS-015 692

### ACQUISITION

FIRST RESULTS OF EXACT ACCIDENT DATA  
ACQUISITION ON SCENE

HS-015 674

### ADVISORY

ALGORITHM FOR A REAL-TIME ADVISORY SIGN  
CONTROL SYSTEM FOR URBAN HIGHWAYS

HS-015 790

### AIDS

DWI LAW ENFORCEMENT TRAINING PROJECT.  
EVALUATION AIDS PACKET AND MEDIA LOG

HS-801 345

### AIM

A PROCEDURE FOR THE PHOTOMETRIC DETER-  
MINATION OF HEADLAMP AIM BY ISOLUX CON-  
TOUR MATCHING

HS-015 698

### AIR

AN INTRODUCTION TO SCALE MODEL TESTING TO  
DETERMINE AIR CUSHION CRASH SENSOR LOCA-  
TION

HS-015 691

HUMAN VOLUNTEER AND ANTHROPOMORPHIC  
DUMMY TESTS OF GENERAL MOTORS DRIVER AIR  
CUSHION SYSTEM

HS-015 684

STUDY ON AIR BAG SYSTEMS FOR NISSAN SMALL-  
SIZED CARS

HS-015 683

THE DEVELOPMENT OF AN AIR BAG ON COLLAPSI-  
BLE DASHBOARD RESTRAINT SYSTEM FOR RIGHT  
FRONT SEAT OCCUPANTS

HS-015 682

### AIRCREW MEN

IMPROVED RESTRAINT FOR U. S. ARMY AIR-  
CREW MEN

HS-015 690

### ALCOHOL

ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SUR-  
VEYS OF DRINKING-DRIVING BEHAVIOR: A  
REVIEW OF THE LITERATURE AND A RECOM-  
MENDED METHODOLOGY

HS-015 823

EXAMINATION OF ALCOHOL INTOXICATION IN  
CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A  
MATHEMATICAL ANALYSIS OF THE RELATIONSHIP  
BETWEEN THE RESULTS OF CLINICAL EXAMINA-  
TION AND BLOOD ALCOHOL

HS-015 784

IDENTIFICATION OF COUNTERMEASURES FOR THE  
YOUTH CRASH PROBLEM RELATED TO ALCOHOL.  
FINAL REPORT

HS-801 344

### ALGORITHM

ALGORITHM FOR A REAL-TIME ADVISORY SIGN  
CONTROL SYSTEM FOR URBAN HIGHWAYS

HS-015 790

### ALUMINUM

DEVELOPMENT OF APPROACH RAIL-BRIDGE RAIL  
TRANSITION USING ALUMINUM BALANCED  
SYSTEM

HS-015 797

### AMBULANT

AN INVESTIGATION OF FACTORS AFFECTING THE  
USE OF BUSES BY BOTH ELDERLY AND AMBU-  
LANT DISABLED PERSONS

HS-015 669

### ANALYSES

SURVEY OF SOLUTION PROCEDURES FOR NON-  
LINEAR STATIC AND DYNAMIC ANALYSES

HS-015 707

### ANGLE

ANGLE AND SMALL-CAR IMPACT TESTS OF AN AR-  
TICULATED GORE BARRIER EMPLOYING  
LIGHTWEIGHT CONCRETE ENERGY-ABSORBING  
CARTRIDGES

HS-015 792

### ANOTHER

ELECTRIC CARS--SET FOR ANOTHER COMEBACK

HS-015 748

### ANTHROPOMORPHIC

GM-ATD 502 ANTHROPOMORPHIC DUMMY--  
DEVELOPMENT AND EVALUATION

HS-015 697

HUMAN VOLUNTEER AND ANTHROPOMORPHIC  
DUMMY TESTS OF GENERAL MOTORS DRIVER AIR  
CUSHION SYSTEM

HS-015 684

**APPLICABILITY**

SCALE MODELING OF VEHICLE CRASHES--  
TECHNIQUES, APPLICABILITY, AND ACCURACY;  
COST EFFECTIVENESS

HS-015 692

**APPLICATION**

APPLICATION OF FINITE ELEMENT METHODS TO  
COMPLETE AUTOMOBILE STRUCTURAL DESIGN  
EVALUATION

HS-015 712

APPLICATION OF GRID SELECTION PROCEDURES  
FOR IMPROVED FINITE ELEMENT STRESS ANALY-  
SIS

HS-015 726

INTERNATIONAL CONFERENCE ON VEHICLE  
STRUCTURAL MECHANICS: FINITE ELEMENT AP-  
PLICATION TO VEHICLE DESIGN, PROCEEDINGS,  
DETROIT, MICHIGAN, MARCH 26-28, 1974

HS-015 706

**APPLICATIONS**

APPLICATIONS OF COMPUTER-GENERATED  
IMAGERY TO DRIVER TRAINING; HIGHWAY  
RESEARCH, AND DESIGN

HS-015 737

**APPLIED**

FINITE ELEMENT STRUCTURAL ANALYSIS AS AP-  
PLIED TO AN AUTOMOTIVE DOOR STRUCTURE

HS-015 710

OPTIMIZATION TECHNIQUES APPLIED TO IMPROV-  
ING FREEWAY OPERATIONS

HS-015 791

**ARMY**

IMPROVED RESTRAINT FOR U. S. ARMY AIR-  
CREWMEN

HS-015 690

**ARRESTING**

VEHICLE-ARRESTING SYSTEM USING CHAIN-LINK  
FENCE

HS-015 793

**ARTICULATED**

ANGLE AND SMALL-CAR IMPACT TESTS OF AN AR-  
TICULATED GORE BARRIER EMPLOYING  
LIGHTWEIGHT CONCRETE ENERGY-ABSORBING  
CARTRIDGES

HS-015 792

**ASSESSMENT**

INJURY ASSESSMENT OF BELTED CADAVERS.  
PROGRESS REPORT NO. 4, OCTOBER 1974

HS-801 375

INJURY ASSESSMENT OF BELTED CADAVERS.  
PROGRESS REPORT NO. 3, SEPTEMBER 1974

HS-801 376

**ASSOCIATED**

FACTORS ASSOCIATED WITH SAFETY BELT USE IN  
1974 STARTER-INTERLOCK EQUIPPED CARS

HS-015 815

**ATD**

GM-ATD 502 ANTHROPOMORPHIC  
DEVELOPMENT AND EVALUATION

DUMMY--

HS-015 697

**ATTENUATORS**

AUTOMOBILES AND HIGHWAY CRASH ATTENUA-  
TORS: SYSTEM DESIGN CONSIDERATIONS

HS-015 794

**AUF**

INFLUENCES ON THE DRIVING BEHAVIOR OF AU-  
TOMOBILES (EINFLUSSE AUF DAS FAHRVERHAL-  
TEN VON KRAFTFAHRZEUGEN)

HS-015 702

**AUTOMOBILE**

AN INEXPENSIVE AUTOMOBILE CRASH RECORDER

HS-015 673

APPLICATION OF FINITE ELEMENT METHODS TO  
COMPLETE AUTOMOBILE STRUCTURAL DESIGN  
EVALUATION

HS-015 712

AUTOMOBILE COLLISIONS. A MODULE ON ENER-  
GY AND MOMENTUM

HS-015 746

AUTOMOBILE INSURANCE LOSSES COLLISION  
COVERAGES. RELATIONSHIPS BETWEEN LOSSES  
AND VEHICLE DENSITY, 1972 AND 1973 MODELS

HS-015 735

COMPOSITE MATERIALS IN AUTOMOBILE SIDE  
STRUCTURES--FEASIBILITY EVALUATION.  
MONTHLY LETTER REPORT NO. 13, JUNE 1974

HS-801 365

COMPOSITE MATERIALS IN AUTOMOBILE SIDE  
STRUCTURES--FEASIBILITY EVALUATION.  
MONTHLY LETTER REPORT NO. 14, JULY 1974

HS-801 373

DEVELOPMENT AND EVALUATION OF A STRUC-  
TURAL CRASHWORTHINESS SYSTEM FOR A STAN-  
DARD SIZE AUTOMOBILE. EXECUTIVE SUMMARY.  
FINAL REPORT

HS-801 318

DRIVER INJURY IN AUTOMOBILE ACCIDENTS IN-  
VOLVING CERTAIN CAR MODELS: AN UPDATE

HS-015 668

FINITE ELEMENT ANALYSIS OF AUTOMOBILE  
STRUCTURES

HS-015 709

FINITE ELEMENT ANALYSIS, AN AUTOMOBILE EN-  
GINEER'S TOOL

HS-015 728

IMPROVEMENT IN DYNAMIC CHARACTERISTICS OF  
AUTOMOBILE SUSPENSION SYSTEMS. PT. 2. THREE-  
MASS SYSTEMS

HS-015 804

SCHWINGUNGSUNTERSUCHUNGEN AN EINER  
PKW-KAROSSERIE (INVESTIGATIONS INTO THE  
VIBRATIONS OF AN AUTOMOBILE BODY)

HS-015 805

**AUTOMOBILES**

AUTOMOBILES AND HIGHWAY CRASH ATTENUA-  
TORS: SYSTEM DESIGN CONSIDERATIONS

HS-015 794

May 31, 1975

- CRASH ENERGY MANAGEMENT IN SUBCOMPACT AUTOMOBILES**  
HS-015 678
- INFLUENCES ON THE DRIVING BEHAVIOR OF AUTOMOBILES (EINFLUSSE AUF DAS FAHRVERHALTEN VON KRAFTFAHRZEUGEN)**  
HS-015 702
- AUTOS**  
**HYDROGEN-ENRICHED GASOLINE FOR AUTOS**  
HS-015 762
- AXISYMMETRIC**  
**AN AXISYMMETRIC FINITE ELEMENT ANALYSIS OF THE MECHANICAL AND THERMAL STRESSES in brake drums**  
HS-015 711
- BAG**  
**STUDY ON AIR BAG SYSTEMS FOR NISSAN SMALL-SIZED CARS**  
HS-015 683
- THE DEVELOPMENT OF AN AIR BAG ON COLLAPSIBLE DASHBOARD RESTRAINT SYSTEM FOR RIGHT FRONT SEAT OCCUPANTS**  
HS-015 682
- BALANCED**  
**DEVELOPMENT OF APPROACH RAIL-BRIDGE RAIL TRANSITION USING ALUMINUM BALANCED SYSTEM**  
HS-015 797
- BAND**  
**PERFORMANCE OF VOLUNTEER MONITORS USING CITIZENS BAND RADIO FOR A HIGHWAY COMMUNICATIONS SERVICE**  
HS-015 786
- BARBI**  
**BARBI, A NEW RADAR CONCEPT FOR PRECOLLISION SENSING**  
HS-015 680
- BARRIER**  
**ANGLE AND SMALL-CAR IMPACT TESTS OF AN ARTICULATED GORE BARRIER EMPLOYING LIGHTWEIGHT CONCRETE ENERGY-ABSORBING CARTRIDGES**  
HS-015 792
- DEVELOPMENT OF A NEW MEDIAN BARRIER TERMINAL**  
HS-015 795
- BARRIERS**  
**CRASH TEST EVALUATION OF THREE BEAM TRAFFIC BARRIERS**  
HS-015 796
- BASICS**  
**REVIEWING THE BASICS**  
HS-015 766
- BASIS**  
**ENERGY BASIS FOR COLLISION SEVERITY**  
HS-015 671
- BEAM**  
**A TECHNIQUE FOR CONNECTING BEAM ELEMENTS TO A PLATE MODEL OF A COMPLICATED BOX SECTION**  
HS-015 729
- CRASH TEST EVALUATION OF THREE BEAM TRAFFIC BARRIERS**  
HS-015 796
- BEHAVIOR**  
**ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SURVEYS OF DRINKING-DRIVING BEHAVIOR: A REVIEW OF THE LITERATURE AND A RECOMMENDED METHODOLOGY**  
HS-015 823
- DESTINATION CHOICE MODELLING AND THE DISAGGREGATE ANALYSIS OF URBAN TRAVEL BEHAVIOR. FINAL REPORT**  
HS-015 751
- INFLUENCES ON THE DRIVING BEHAVIOR OF AUTOMOBILES (EINFLUSSE AUF DAS FAHRVERHALTEN VON KRAFTFAHRZEUGEN)**  
HS-015 702
- INVESTIGATION OF FLOW-DENSITY DISCONTINUITY AND DUAL-MODE TRAFFIC BEHAVIOR**  
HS-015 789
- PEDESTRIAN BEHAVIOR AT SIGNALISED INTERSECTIONS**  
HS-015 765
- BELT**  
**A FORCE LIMITING SYSTEM ON A THREE-POINT-BELT SYSTEM DEPENDING ON CRASH VELOCITY**  
HS-015 688
- BELT RETRACTOR TESTING WITH STANDARD VEHICLE SEAT. APPENDIX D. MODIFICATION 1.**  
HS-801 386
- DEVELOPMENT OF ENERGY-ABSORBING SAFETY BELT WEBBING**  
HS-015 687
- FACTORS ASSOCIATED WITH SAFETY BELT USE IN 1974 STARTER-INTERLOCK EQUIPPED CARS**  
HS-015 815
- INFLATABLE BELT DEVELOPMENT FOR SUBCOMPACT CAR PASSENGERS. PROGRESS REPORT, SEPTEMBER 1974**  
HS-801 369
- BELTED**  
**INJURY ASSESSMENT OF BELTED CADAVERS. PROGRESS REPORT NO. 4, OCTOBER 1974**  
HS-801 375
- INJURY ASSESSMENT OF BELTED CADAVERS. PROGRESS REPORT NO. 3, SEPTEMBER 1974**  
HS-801 376
- BENCH**  
**DATA FROM FABRICATION OF A STANDARD BENCH VEHICLE SEAT. APPENDIX C**  
HS-801 385
- FABRICATION OF A STANDARD BENCH VEHICLE SEAT. FINAL REPORT**  
HS-801 384

**BENDING**

ELASTIC-PLASTIC PLATE BENDING WITH CONSTANT CURVATURE ELEMENTS

HS-015 708

**BENEFITS**

RTOR: WARRANTS AND BENEFITS. FINAL REPORT

HS-015 752

**BIBLIOGRAPHY**

SIMULATION AND SIMULATORS: A SELECTED BIBLIOGRAPHY

HS-015 740

**BICYCLE**

COMMUTER DEMAND FOR BICYCLE TRANSPORTATION IN THE UNITED STATES

HS-015 700

**BICYCLES**

BICYCLES, CARS AND ENERGY

HS-015 701

**BIOFIDELITY**

DISCUSSION (THE HSRI DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY)

HS-015 695

THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY

HS-015 694

**BLOOD**

EXAMINATION OF ALCOHOL INTOXICATION IN CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A MATHEMATICAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE RESULTS OF CLINICAL EXAMINATION AND BLOOD ALCOHOL

HS-015 784

**BODY**

SCHWINGUNGSUNTERSUCHUNGEN AN EINER PKW-KAROSSERIE (INVESTIGATIONS INTO THE VIBRATIONS OF AN AUTOMOBILE BODY)

HS-015 805

STATIC ANALYSIS VIA SUBSTRUCTURING OF AN EXPERIMENTAL VEHICLE FRONT-END BODY STRUCTURE

HS-015 713

**BOX**

A TECHNIQUE FOR CONNECTING BEAM ELEMENTS TO A PLATE MODEL OF A COMPLICATED BOX SECTION

HS-015 729

**BRAKES**

DESIGNING TRUCK DISC BRAKES

HS-015 763

VEHICLE BRAKING SYSTEMS TEST PROCEDURE--HYDRAULIC BRAKES. FINAL REPORT

HS-801 308

**BRAKING**

BRAKING EFFICIENCY TEST TECHNIQUE. FINAL REPORT

HS-801 352

BRAKING EFFICIENCY TEST TECHNIQUE. SUMMARY REPORT

HS-801 353

VEHICLE BRAKING SYSTEMS TEST PROCEDURE--HYDRAULIC BRAKES. FINAL REPORT

HS-801 308

**BREAKAWAY**

A BREAKAWAY CONCEPT FOR TIMBER UTILITY POLES

HS-015 799

**BRIDGE**

DEVELOPMENT OF APPROACH RAIL-BRIDGE RAIL TRANSITION USING ALUMINUM BALANCED SYSTEM

HS-015 797

**BRIEFING**

SOURCES AND REMEDIES FOR RESTRAINT SYSTEM DISCOMFORT AND INCONVENIENCES. FINAL BRIEFING

HS-801 374

**BUILT**

PEDESTRIANS IN DOWNTOWN: OBSERVING PEOPLE IN THE BUILT ENVIRONMENT

HS-015 828

**BUMPER**

TESTS FOR HAZARDOUS FAILURE OF ENERGY ABSORBING AUTOMOTIVE BUMPER CYLINDERS. REPORT

HS-015 802

**BUSES**

AN INVESTIGATION OF FACTORS AFFECTING THE USE OF BUSES BY BOTH ELDERLY AND AMBULANT DISABLED PERSONS

HS-015 669

**CADAVERS**

INJURY ASSESSMENT OF BELTED CADAVERS. PROGRESS REPORT NO. 4, OCTOBER 1974

HS-801 375

INJURY ASSESSMENT OF BELTED CADAVERS. PROGRESS REPORT NO. 3, SEPTEMBER 1974

HS-801 376

**CALCULATION**

THE USE OF ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS IN THE CALCULATION OF CUMULATIVE FATIGUE DAMAGE

HS-015 714

**CALIFORNIA**

AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. ABSTRACT

HS-015 780

AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. FINAL REPORT

HS-015 781

**CAPACITY**

DETECTION OF FREEWAY CAPACITY-REDUCING INCIDENTS BY TRAFFIC-STREAM MEASUREMENTS

HS-015 785

May 31, 1975

## CAR

ANGLE AND SMALL-CAR IMPACT TESTS OF AN ARTICULATED GORE BARRIER EMPLOYING LIGHTWEIGHT CONCRETE ENERGY-ABSORBING CARTRIDGES

HS-015 792

DRIVE YOUR CAR SAFELY

HS-015 814

DRIVER INJURY IN AUTOMOBILE ACCIDENTS INVOLVING CERTAIN CAR MODELS: AN UPDATE

HS-015 668

INFLATABLE BELT DEVELOPMENT FOR SUBCOMPACT CAR PASSENGERS. PROGRESS REPORT, SEPTEMBER 1974

HS-801 369

SHOCK ABSORBERS FOR YOUR CAR. PT. 2: DYNAMOMETER, TRACK AND ROAD TESTS OF 10 SHOCKS ON A CORVETTE

HS-015 749

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, SEPTEMBER 1974

HS-801 361

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, AUGUST 1974

HS-801 367

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, JULY 1974

HS-801 368

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, NOVEMBER 1974

HS-801 377

TRAILER POINTERS AND DRIVING HINTS FOR PASSENGER CAR OWNERS

HS-015 761

## CARS

BICYCLES, CARS AND ENERGY

HS-015 701

ELECTRIC CARS--SET FOR ANOTHER COMEBACK

HS-015 748

FACTORS ASSOCIATED WITH SAFETY BELT USE IN 1974 STARTER-INTERLOCK EQUIPPED CARS

HS-015 815

PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT (21ST), 1 MARCH TO 31 MARCH 1974

HS-801 364

PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT NO. 22, APRIL 1974

HS-801 378

STUDY ON AIR BAG SYSTEMS FOR NISSAN SMALL-SIZED CARS

HS-015 683

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE CRASHWORTHINESS OF SMALL CARS

HS-015 679

## CARTRIDGES

ANGLE AND SMALL-CAR IMPACT TESTS OF AN ARTICULATED GORE BARRIER EMPLOYING

LIGHTWEIGHT CONCRETE ENERGY-ABSORBING CARTRIDGES

HS-015 792

## CASES

EXAMINATION OF ALCOHOL INTOXICATION IN CASES OF SUSPECTED DRUNKEN DRIVERS. 2. A MATHEMATICAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE RESULTS OF CLINICAL EXAMINATION AND BLOOD ALCOHOL

HS-015 784

## CATALYTIC

ALL ABOUT CATALYTIC CONVERTERS. HOW THEY WORK AND WHAT YOU CAN EXPECT IN PERFORMANCE

HS-015 767

## CAUSES

TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS. VOL. 1--RESEARCH FINDINGS. FINAL REPORT

HS-801 334

TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS: INTERIM REPORT I. VOL. 2--APPENDICES.

HS-801 335

## CHAIN

VEHICLE-ARRESTING SYSTEM USING CHAIN-LINK FENCE

HS-015 793

## CHARACTERISTICS

IMPROVEMENT IN DYNAMIC CHARACTERISTICS OF AUTOMOBILE SUSPENSION SYSTEMS. PT. 2. THREE-MASS SYSTEMS

HS-015 804

## CHARACTERIZATION

FRONT END STRUCTURES CRASH RESPONSE CHARACTERIZATION

HS-015 677

## CHECKOUT

FINITE ELEMENT MODEL DATA CHECKOUT WITH INTERACTIVE GRAPHICS

HS-015 731

## CHEST

HUMAN CHEST IMPACT PROTECTION CRITERIA

HS-015 696

## CHILD

THE EFFORTS OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION IN THE DEVELOPMENT OF ADVANCED PASSIVE PROTECTION SYSTEMS AND CHILD RESTRAINT SYSTEMS

HS-015 686

## CHOICE

DESTINATION CHOICE MODELLING AND THE DISAGGREGATE ANALYSIS OF URBAN TRAVEL BEHAVIOR. FINAL REPORT

HS-015 751

## CIRCULATION

PEDESTRIAN CIRCULATION PLANNING: PRINCIPLES, PROCEDURES, PROTOTYPES

HS-015 826

**CITIZENS**

PERFORMANCE OF VOLUNTEER MONITORS USING  
CITIZENS BAND RADIO FOR A HIGHWAY COMMU-  
NICATIONS SERVICE

HS-015 786

**CITY**

THE ENVIRONMENTAL QUALITY OF CITY  
STREETS: THE RESIDENTS' VIEWPOINT

HS-015 829

**CLINICAL**

EXAMINATION OF ALCOHOL INTOXICATION IN  
CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A  
MATHEMATICAL ANALYSIS OF THE RELATIONSHIP  
BETWEEN THE RESULTS OF CLINICAL EXAMINA-  
TION AND BLOOD ALCOHOL

HS-015 784

**CLUTCH**

A NEW WET CLUTCH FAN DRIVE SYSTEM

HS-015 821

**COLLAPSIBLE**

THE DEVELOPMENT OF AN AIR BAG ON COLLAPSI-  
BLE DASHBOARD RESTRAINT SYSTEM FOR RIGHT  
FRONT SEAT OCCUPANTS

HS-015 682

**COLLECTING**

A PROPOSED NEW NATIONAL SYSTEM FOR COL-  
LECTING MULTIPURPOSE ACCIDENT DATA: SIR

HS-015 757

**COLLISION**

AUTOMOBILE INSURANCE LOSSES COLLISION  
COVERAGES. RELATIONSHIPS BETWEEN LOSSES  
AND VEHICLE DENSITY, 1972 AND 1973 MODELS

HS-015 735

ENERGY BASIS FOR COLLISION SEVERITY

HS-015 671

**COLLISIONS**

AUTOMOBILE COLLISIONS. A MODULE ON ENER-  
GY AND MOMENTUM

HS-015 746

**COMMONWEALTH**

CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT. COM-  
MONWEALTH OF PUERTO RICO. 1971 ACCIDENT  
YEAR

HS-015 771

**COMMUNICATIONS**

PERFORMANCE OF VOLUNTEER MONITORS USING  
CITIZENS BAND RADIO FOR A HIGHWAY COMMU-  
NICATIONS SERVICE

HS-015 786

**COMMUTER**

COMMUTER DEMAND FOR BICYCLE TRANSPORTA-  
TION IN THE UNITED STATES

HS-015 700

**COMPARED**

DISCUSSION (THE HSRI DUMMY COMPARED WITH  
GENERAL MOTORS BIOFIDELITY RECOMMENDA-  
TIONS AND THE HYBRID 2 DUMMY)

HS-015 695

THE HIGHWAY SAFETY RESEARCH INSTITUTE  
DUMMY COMPARED WITH GENERAL MOTORS  
BIOFIDELITY RECOMMENDATIONS AND THE  
HYBRID 2 DUMMY

HS-015 694

**COMPARISONS**

FULL-SCALE EMBANKMENT TESTS AND COM-  
PARISONS WITH A COMPUTER SIMULATION

HS-015 798

**COMPLETE**

APPLICATION OF FINITE ELEMENT METHODS TO  
COMPLETE AUTOMOBILE STRUCTURAL DESIGN  
EVALUATION

HS-015 712

**COMPLEX**

AN INTERACTIVE HYBRID TECHNIQUE FOR  
CRASHWORTHY DESIGN OF COMPLEX VEHICULAR  
STRUCTURAL SYSTEMS

HS-015 717

**COMPLICATED**

A TECHNIQUE FOR CONNECTING BEAM ELEMENTS  
TO A PLATE MODEL OF A COMPLICATED BOX SEC-  
TION

HS-015 729

**COMPONENT**

DIESEL ENGINE COMPONENT DESIGN USING THE  
FINITE ELEMENT METHOD AND INTERACTIVE  
GRAPHICS

HS-015 727

**COMPOSITE**

COMPOSITE MATERIALS IN AUTOMOBILE SIDE  
STRUCTURES--FEASIBILITY EVALUATION.  
MONTHLY LETTER REPORT NO. 13, JUNE 1974

HS-801 365

COMPOSITE MATERIALS IN AUTOMOBILE SIDE  
STRUCTURES--FEASIBILITY EVALUATION.  
MONTHLY LETTER REPORT NO. 14, JULY 1974

HS-801 373

**COMPRESSION**

COMPRESSION OF AN INFLATED TUBE BETWEEN  
RIGID SURFACES AS AN ELEMENTARY TIRE  
MECHANICS MODEL

HS-015 810

**COMPUTATION**

THE COMPUTATION OF TEARING ENERGY OF  
NICKED RUBBER STRIPS IN EXTENSION

HS-015 715

**COMPUTER**

APPLICATIONS OF COMPUTER-GENERATED  
IMAGERY TO DRIVER TRAINING; HIGHWAY  
RESEARCH, AND DESIGN

HS-015 737

DIGITAL COMPUTER

HS-015 770

FULL-SCALE EMBANKMENT TESTS AND COM-  
PARISONS WITH A COMPUTER SIMULATION

HS-015 798

GENERATION OF FINITE ELEMENT MODELS VIA  
COMPUTER GRAPHICS

HS-015 732

May 31, 1975

POWER SPECTRAL DENSITY ANALYSIS OF VEHICLE VIBRATION USING THE NASTRAN COMPUTER PROGRAM

HS-015 718

#### CONCENTRATED

STIFFNESS ANALYSIS OF SHEET METAL SHELLS UNDER CONCENTRATED LOADS

HS-015 725

#### CONCEPT

A BREAKAWAY CONCEPT FOR TIMBER UTILITY POLES

HS-015 799

BARBI, A NEW RADAR CONCEPT FOR PRECOLLISION SENSING

HS-015 680

#### CONCRETE

ANGLE AND SMALL-CAR IMPACT TESTS OF AN ARTICULATED GORE BARRIER EMPLOYING LIGHTWEIGHT CONCRETE ENERGY-ABSORBING CARTRIDGES

HS-015 792

#### CONDENSATION

THE USE OF CONDENSATION TECHNIQUES FOR SOLVING DYNAMICS PROBLEMS

HS-015 720

#### CONFERENCE

INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, TROY, MICHIGAN, JULY 10-12, 1974

HS-015 670

INTERNATIONAL CONFERENCE ON VEHICLE STRUCTURAL MECHANICS: FINITE ELEMENT APPLICATION TO VEHICLE DESIGN, PROCEEDINGS, DETROIT, MICHIGAN, MARCH 26-28, 1974

HS-015 706

#### CONFLICTS

THE TRAFFIC CONFLICTS TECHNIQUE: AN ACCIDENT PREDICTION METHOD

HS-015 801

#### CONGRESS

POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. REPORT TO THE CONGRESS

HS-015 768

#### CONNECTING

A TECHNIQUE FOR CONNECTING BEAM ELEMENTS TO A PLATE MODEL OF A COMPLICATED BOX SECTION

HS-015 729

#### CONSIDERATIONS

AUTOMOBILES AND HIGHWAY CRASH ATTENUATORS: SYSTEM DESIGN CONSIDERATIONS

HS-015 794

#### CONSTANT

ELASTIC-PLASTIC PLATE BENDING WITH CONSTANT CURVATURE ELEMENTS

HS-015 708

#### CONSUMER

ROAD SAFETY AND THE CONSUMER. A MAJOR NEW RESEARCH INITIATIVE

HS-015 818

#### CONTEMPORARY

A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY PREPARED ON RULES OF THE ROAD UNIFORMITY IN THE TRAFFIC LAWS OF THE SEVERAL STATES

HS-820 262

#### CONTOUR

A PROCEDURE FOR THE PHOTOMETRIC DETERMINATION OF HEADLAMP AIM BY ISOLUX CONTOUR MATCHING

HS-015 698

#### CONTOURING

CONTOURING THE TIRE SIDEWALL WITH MOIRE

HS-015 811

#### CONTROL

ALGORITHM FOR A REAL-TIME ADVISORY SIGN CONTROL SYSTEM FOR URBAN HIGHWAYS

HS-015 790

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS. PT. 7: TRAFFIC CONTROLS FOR SCHOOL AREAS

HS-015 822

#### CONTROLS

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS. PT. 7: TRAFFIC CONTROLS FOR SCHOOL AREAS

HS-015 822

#### CONVERTERS

ALL ABOUT CATALYTIC CONVERTERS. HOW THEY WORK AND WHAT YOU CAN EXPECT IN PERFORMANCE

HS-015 767

#### CORVETTE

SHOCK ABSORBERS FOR YOUR CAR. PT. 2: DYNAMOMETER, TRACK AND ROAD TESTS OF 10 SHOCKS ON A CORVETTE

HS-015 749

#### COST

SCALE MODELING OF VEHICLE CRASHES--TECHNIQUES, APPLICABILITY, AND ACCURACY; COST EFFECTIVENESS

HS-015 692

#### COUNTERMEASURES

IDENTIFICATION OF COUNTERMEASURES FOR THE YOUTH CRASH PROBLEM RELATED TO ALCOHOL. FINAL REPORT

HS-801 344

#### COURTS

HIGHWAY SAFETY PROGRAM MANUAL. VOL. 7. TRAFFIC COURTS

HS-801 349

**COVERAGES**

AUTOMOBILE INSURANCE LOSSES COLLISION COVERAGES. RELATIONSHIPS BETWEEN LOSSES AND VEHICLE DENSITY, 1972 AND 1973 MODELS

HS-015 735

**CRASH**

A FORCE LIMITING SYSTEM ON A THREE-POINT-BELT SYSTEM DEPENDING ON CRASH VELOCITY

HS-015 688

A USER-ORIENTED PROGRAM FOR CRASH DYNAMICS

HS-015 721

AN INEXPENSIVE AUTOMOBILE CRASH RECORDER

HS-015 673

AN INTRODUCTION TO SCALE MODEL TESTING TO DETERMINE AIR CUSHION CRASH SENSOR LOCATION

HS-015 691

AUTOMOBILES AND HIGHWAY CRASH ATTENUATORS: SYSTEM DESIGN CONSIDERATIONS

HS-015 794

CRASH ENERGY MANAGEMENT IN SUBCOMPACT AUTOMOBILES

HS-015 678

CRASH TEST EVALUATION OF THREE BEAM TRAFFIC BARRIERS

HS-015 796

CRASH TESTS AND EVALUATION OF SINGLE POST HIGHWAY SIGNS. INTERIM REPORT

HS-015 782

FLUID CRASH SENSOR

HS-015 681

FRONT END STRUCTURES CRASH RESPONSE CHARACTERIZATION

HS-015 677

IDENTIFICATION OF COUNTERMEASURES FOR THE YOUTH CRASH PROBLEM RELATED TO ALCOHOL. FINAL REPORT

HS-801 344

TEST SLED SIMULATION OF CRASH INDUCED YAW AND PITCH

HS-015 693

TESTING CRASH DUMMIES

HS-015 753

USER'S MANUAL FOR UCIN VEHICLE-OCCUPANT CRASH-STUDY MODEL

HS-015 769

**CRASHES**

SCALE MODELING OF VEHICLE CRASHES--TECHNIQUES, APPLICABILITY, AND ACCURACY; COST EFFECTIVENESS

HS-015 692

**CRASHWORTHINESS**

DEVELOPMENT AND EVALUATION OF A STRUCTURAL CRASHWORTHINESS SYSTEM FOR A STANDARD SIZE AUTOMOBILE. EXECUTIVE SUMMARY. FINAL REPORT

HS-801 318

PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT (21ST), 1 MARCH TO 31 MARCH 1974

HS-801 364

PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT NO. 22, APRIL 1974

HS-801 378

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, SEPTEMBER 1974

HS-801 361

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, AUGUST 1974

HS-801 367

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, JULY 1974

HS-801 368

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, NOVEMBER 1974

HS-801 377

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE CRASHWORTHINESS OF SMALL CARS

HS-015 679

**CRASHWORTHY**

AN INTERACTIVE HYBRID TECHNIQUE FOR CRASHWORTHY DESIGN OF COMPLEX VEHICULAR STRUCTURAL SYSTEMS

HS-015 717

**CRITERIA**

HUMAN CHEST IMPACT PROTECTION CRITERIA

HS-015 696

USE OF MATHEMATICAL SIMULATIONS TO DEVELOP SAFER HIGHWAY DESIGN CRITERIA

HS-015 739

**CROSSING**

ANALYSIS OF DRIVER REACTION TO WARNING DEVICES AT A HIGH-ACCIDENT RURAL GRADE CROSSING. FINAL REPORT

HS-015 750

**CUMULATIVE**

THE USE OF ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS IN THE CALCULATION OF CUMULATIVE FATIGUE DAMAGE

HS-015 714

**CURVATURE**

ELASTIC-PLASTIC PLATE BENDING WITH CONSTANT CURVATURE ELEMENTS

HS-015 708

**CUSHION**

AN INTRODUCTION TO SCALE MODEL TESTING TO DETERMINE AIR CUSHION CRASH SENSOR LOCATION

HS-015 691

HUMAN VOLUNTEER AND ANTHROPOMORPHIC DUMMY TESTS OF GENERAL MOTORS DRIVER AIR CUSHION SYSTEM

HS-015 684



May 31, 1975

#### **CYLINDERS**

TESTS FOR HAZARDOUS FAILURE OF ENERGY ABSORBING AUTOMOTIVE BUMPER CYLINDERS. REPORT

HS-015 802

#### **DAMAGE**

THE USE OF ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS IN THE CALCULATION OF CUMULATIVE FATIGUE DAMAGE

HS-015 714

#### **DASHBOARD**

THE DEVELOPMENT OF AN AIR BAG ON COLLAPSIBLE DASHBOARD RESTRAINT SYSTEM FOR RIGHT FRONT SEAT OCCUPANTS

HS-015 682

#### **DEFORMATION**

THE ROLE OF FINITE DEFORMATION ANALYSIS IN PLANE STRESS AND STRAIN FRACTURES

HS-015 722

TIRE DEFORMATION DURING DYNAMIC HYDROPLANING

HS-015 755

#### **DEMAND**

COMMUTER DEMAND FOR BICYCLE TRANSPORTATION IN THE UNITED STATES

HS-015 700

#### **DENSITY**

AUTOMOBILE INSURANCE LOSSES COLLISION COVERAGES. RELATIONSHIPS BETWEEN LOSSES AND VEHICLE DENSITY, 1972 AND 1973 MODELS

HS-015 735

DESIGN OF DENSITY-MEASURING SYSTEMS FOR ROADWAYS

HS-015 788

INVESTIGATION OF FLOW-DENSITY DISCONTINUITY AND DUAL-MODE TRAFFIC BEHAVIOR

HS-015 789

POWER SPECTRAL DENSITY ANALYSIS OF VEHICLE VIBRATION USING THE NASTRAN COMPUTER PROGRAM

HS-015 718

#### **DEPENDENT**

A FORCE LIMITING SYSTEM ON A THREE-POINT-BELT SYSTEM DEPENDENT ON CRASH VELOCITY

HS-015 688

#### **DEPTH**

IN-DEPTH ACCIDENT DATA AND OCCUPANT PROTECTION--A STATISTICAL POINT OF VIEW

HS-015 675

#### **DESIGNING**

DESIGNING TRUCK DISC BRAKES

HS-015 763

#### **DESTINATION**

DESTINATION CHOICE MODELLING AND THE DISAGGREGATE ANALYSIS OF URBAN TRAVEL BEHAVIOR. FINAL REPORT

HS-015 751

#### **DETECTION**

DETECTION OF FREEWAY CAPACITY-REDUCING INCIDENTS BY TRAFFIC-STREAM MEASUREMENTS

HS-015 785

#### **DETECTOR**

STUDY OF DETECTOR RELIABILITY FOR A MOTORIST INFORMATION SYSTEM ON THE GULF FREEWAY

HS-015 787

#### **DETROIT**

INTERNATIONAL CONFERENCE ON VEHICLE STRUCTURAL MECHANICS: FINITE ELEMENT APPLICATION TO VEHICLE DESIGN, PROCEEDINGS, DETROIT, MICHIGAN, MARCH 26-28, 1974

HS-015 706

#### **DEVICES**

ANALYSIS OF DRIVER REACTION TO WARNING DEVICES AT A HIGH-ACCIDENT RURAL GRADE CROSSING. FINAL REPORT

HS-015 750

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS. PT. 7: TRAFFIC CONTROLS FOR SCHOOL AREAS

HS-015 822

#### **DIESEL**

DIESEL ENGINE COMPONENT DESIGN USING THE FINITE ELEMENT METHOD AND INTERACTIVE GRAPHICS

HS-015 727

#### **DIGITAL**

DIGITAL COMPUTER

HS-015 770

#### **DISABLED**

AN INVESTIGATION OF FACTORS AFFECTING THE USE OF BUSES BY BOTH ELDERLY AND AMBULANT DISABLED PERSONS

HS-015 669

#### **DISAGGREGATE**

DESTINATION CHOICE MODELLING AND THE DISAGGREGATE ANALYSIS OF URBAN TRAVEL BEHAVIOR. FINAL REPORT

HS-015 751

#### **DISC**

DESIGNING TRUCK DISC BRAKES

HS-015 763

#### **DISCOMFORT**

SOURCES AND REMEDIES FOR RESTRAINT SYSTEM DISCOMFORT AND INCONVENIENCES. FINAL BRIEFING

HS-801 374

#### **DISCONTINUITY**

INVESTIGATION OF FLOW-DENSITY DISCONTINUITY AND DUAL-MODE TRAFFIC BEHAVIOR

HS-015 789

#### **DISPLACEMENT**

LARGE DISPLACEMENT, NONLINEAR TRANSIENT ANALYSIS BY FINITE ELEMENTS

HS-015 724

**DOOR**

FINITE ELEMENT STRUCTURAL ANALYSIS AS APPLIED TO AN AUTOMOTIVE DOOR STRUCTURE  
HS-015 710

**DOWNTOWN**

PEDESTRIANS IN DOWNTOWN: OBSERVING PEOPLE IN THE BUILT ENVIRONMENT  
HS-015 828

**DRINK**

DRINKING AND DRIVING AFTER IT'S LEGAL TO DRINK AT 18  
HS-015 747

**DRINKING**

ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SURVEYS OF DRINKING-DRIVING BEHAVIOR: A REVIEW OF THE LITERATURE AND A RECOMMENDED METHODOLOGY  
HS-015 823

DRINKING AND DRIVING AFTER IT'S LEGAL TO DRINK AT 18  
HS-015 747

DRINKING-DRIVING IN THE PROVINCE OF ONTARIO  
HS-015 824

**DRIVE**

A NEW WET CLUTCH FAN DRIVE SYSTEM  
HS-015 821

DRIVE YOUR CAR SAFELY  
HS-015 814

**DRIVER**

AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. ABSTRACT  
HS-015 780

AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. FINAL REPORT  
HS-015 781

ANALYSIS OF DRIVER REACTION TO WARNING DEVICES AT A HIGH-ACCIDENT RURAL GRADE CROSSING. FINAL REPORT  
HS-015 750

APPLICATIONS OF COMPUTER-GENERATED IMAGERY TO DRIVER TRAINING; HIGHWAY RESEARCH, AND DESIGN  
HS-015 737

DRIVER INJURY IN AUTOMOBILE ACCIDENTS INVOLVING CERTAIN CAR MODELS: AN UPDATE  
HS-015 668

HUMAN VOLUNTEER AND ANTHROPOMORPHIC DUMMY TESTS OF GENERAL MOTORS DRIVER AIR CUSHION SYSTEM  
HS-015 684

SIMULATION: ITS ROLE IN DRIVER RESEARCH AND HIGHWAY DESIGN. VOL. 8  
HS-015 736

THE IMPACT OF DRIVER IMPROVEMENT: DO WE REALLY WANT TO KNOW?  
HS-015 703

**DRIVERS**

EXAMINATION OF ALCOHOL INTOXICATION IN CASES OF SUSPECTED DRUNKEN DRIVERS. 2. A MATHEMATICAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE RESULTS OF CLINICAL EXAMINATION AND BLOOD ALCOHOL  
HS-015 784

HOW DRIVERS PREVENTED FROM DRIVING WOULD REACH WORK: IMPLICATIONS FOR PENALTIES  
HS-015 816

**DRIVING**

ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SURVEYS OF DRINKING-DRIVING BEHAVIOR: A REVIEW OF THE LITERATURE AND A RECOMMENDED METHODOLOGY  
HS-015 823

DRINKING AND DRIVING AFTER IT'S LEGAL TO DRINK AT 18  
HS-015 747

DRINKING-DRIVING IN THE PROVINCE OF ONTARIO  
HS-015 824

HOW DRIVERS PREVENTED FROM DRIVING WOULD REACH WORK: IMPLICATIONS FOR PENALTIES  
HS-015 816

INFLUENCES ON THE DRIVING BEHAVIOR OF AUTOMOBILES (EINFLUSSE AUF DAS FAHRVERHALTEN VON KRAFTFAHRZEUGEN)  
HS-015 702

TRAILER POINTERS AND DRIVING HINTS FOR PASSENGER CAR OWNERS  
HS-015 761

**DRUG**

DRUG EFFECTS ON VISION: STRATEGIES FOR STUDY AND SELECTED RESULTS  
HS-015 699

**DRUNKEN**

EXAMINATION OF ALCOHOL INTOXICATION IN CASES OF SUSPECTED DRUNKEN DRIVERS. 2. A MATHEMATICAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE RESULTS OF CLINICAL EXAMINATION AND BLOOD ALCOHOL  
HS-015 784

**DUAL**

INVESTIGATION OF FLOW-DENSITY DISCONTINUITY AND DUAL-MODE TRAFFIC BEHAVIOR  
HS-015 789

**DUMMIES**

TESTING CRASH DUMMIES  
HS-015 753

**DUMMY**

DISCUSSION (THE HSRI DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY)  
HS-015 695

GM-ATD 502 ANTHROPOMORPHIC DUMMY--DEVELOPMENT AND EVALUATION  
HS-015 697

May 31, 1975

- HUMAN VOLUNTEER AND ANTHROPOMORPHIC DUMMY TESTS OF GENERAL MOTORS DRIVER AIR CUSHION SYSTEM**  
HS-015 684
- THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY**  
HS-015 694
- DWI**  
DWI LAW ENFORCEMENT TRAINING PROJECT. EVALUATION AIDS PACKET AND MEDIA LOG  
HS-801 345
- DYNAMIC**  
A MODAL SYNTHESIS TECHNIQUE FOR DETERMINING DYNAMIC PROPERTIES FOR A STRUCTURE FOR MASS AND STIFFNESS CHANGES  
HS-015 719
- IMPROVEMENT IN DYNAMIC CHARACTERISTICS OF AUTOMOBILE SUSPENSION SYSTEMS. PT. 2. THREE-MASS SYSTEMS**  
HS-015 804
- NASTRAN FOR DYNAMIC ANALYSIS OF VEHICLE SYSTEMS**  
HS-015 716
- SURVEY OF SOLUTION PROCEDURES FOR NON-LINEAR STATIC AND DYNAMIC ANALYSES**  
HS-015 707
- TIRE DEFORMATION DURING DYNAMIC HYDROPLANING**  
HS-015 755
- DYNAMICS**  
A USER-ORIENTED PROGRAM FOR CRASH DYNAMICS  
HS-015 721
- THE USE OF CONDENSATION TECHNIQUES FOR SOLVING DYNAMICS PROBLEMS**  
HS-015 720
- DYNAMOMETER**  
SHOCK ABSORBERS FOR YOUR CAR. PT. 2: DYNAMOMETER, TRACK AND ROAD TESTS OF 10 SHOCKS ON A CORVETTE  
HS-015 749
- ECE**  
PROCEDURES AND TECHNIQUES FOR PHOTOMETRIC MEASUREMENT OF GONIOMETER-MOUNTED SAE AND ECE HEADLAMPS  
HS-015 800
- ECONOMY**  
POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. REPORT TO THE CONGRESS  
HS-015 768
- EFFECTIVENESS**  
SCALE MODELING OF VEHICLE CRASHES--TECHNIQUES, APPLICABILITY, AND ACCURACY; COST EFFECTIVENESS  
HS-015 692
- EFFICIENCY**  
BRAKING EFFICIENCY TEST TECHNIQUE. FINAL REPORT  
HS-801 352
- BRAKING EFFICIENCY TEST TECHNIQUE. SUMMARY REPORT**  
HS-801 353
- EFFORTS**  
THE EFFORTS OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION IN THE DEVELOPMENT OF ADVANCED PASSIVE PROTECTION SYSTEMS AND CHILD RESTRAINT SYSTEMS  
HS-015 686
- EINFLUSSE**  
INFLUENCES ON THE DRIVING BEHAVIOR OF AUTOMOBILES (EINFLUSSE AUF DAS FAHRVERHALTEN VON KRAFTFAHRZEUGEN)  
HS-015 702
- ELASTIC**  
ELASTIC-PLASTIC PLATE BENDING WITH CONSTANT CURVATURE ELEMENTS  
HS-015 708
- THE USE OF ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS IN THE CALCULATION OF CUMULATIVE FATIGUE DAMAGE**  
HS-015 714
- ELASTO**  
ELASTO-PLASTIC ANALYSIS OF STRESS IN A GAS-TURBINE WHEEL  
HS-015 723
- ELDERLY**  
AN INVESTIGATION OF FACTORS AFFECTING THE USE OF BUSES BY BOTH ELDERLY AND AMBULANT DISABLED PERSONS  
HS-015 669
- ELECTRIC**  
ELECTRIC CARS--SET FOR ANOTHER COMEBACK  
HS-015 748
- ELEMENT**  
AN AXISYMMETRIC FINITE ELEMENT ANALYSIS OF THE MECHANICAL AND THERMAL STRESSES in brake drums  
HS-015 711
- APPLICATION OF FINITE ELEMENT METHODS TO COMPLETE AUTOMOBILE STRUCTURAL DESIGN EVALUATION**  
HS-015 712
- APPLICATION OF GRID SELECTION PROCEDURES FOR IMPROVED FINITE ELEMENT STRESS ANALYSIS**  
HS-015 726
- DIESEL ENGINE COMPONENT DESIGN USING THE FINITE ELEMENT METHOD AND INTERACTIVE GRAPHICS**  
HS-015 727
- FINITE ELEMENT ANALYSIS OF AUTOMOBILE STRUCTURES**  
HS-015 709
- FINITE ELEMENT ANALYSIS, AN AUTOMOBILE ENGINEER'S TOOL**  
HS-015 728

- FINITE ELEMENT MODEL DATA CHECKOUT WITH INTERACTIVE GRAPHICS**  
HS-015 731
- FINITE ELEMENT STRUCTURAL ANALYSIS AS APPLIED TO AN AUTOMOTIVE DOOR STRUCTURE**  
HS-015 710
- GENERATION OF FINITE ELEMENT MODELS VIA COMPUTER GRAPHICS**  
HS-015 732
- INTERNATIONAL CONFERENCE ON VEHICLE STRUCTURAL MECHANICS: FINITE ELEMENT APPLICATION TO VEHICLE DESIGN, PROCEEDINGS, DETROIT, MICHIGAN, MARCH 26-28, 1974**  
HS-015 706
- THE USE OF ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS IN THE CALCULATION OF CUMULATIVE FATIGUE DAMAGE**  
HS-015 714
- USING INTERACTIVE GRAPHICS FOR THE PREPARATION AND MANAGEMENT OF FINITE ELEMENT DATA**  
HS-015 734
- ELEMENTARY**  
COMPRESSION OF AN INFLATED TUBE BETWEEN RIGID SURFACES AS AN ELEMENTARY TIRE MECHANICS MODEL  
HS-015 810
- ELEMENTS**  
A TECHNIQUE FOR CONNECTING BEAM ELEMENTS TO A PLATE MODEL OF A COMPLICATED BOX SECTION  
HS-015 729
- ELASTIC-PLASTIC PLATE BENDING WITH CONSTANT CURVATURE ELEMENTS**  
HS-015 708
- LARGE DISPLACEMENT, NONLINEAR TRANSIENT ANALYSIS BY FINITE ELEMENTS**  
HS-015 724
- EMBANKMENT**  
FULL-SCALE EMBANKMENT TESTS AND COMPARISONS WITH A COMPUTER SIMULATION  
HS-015 798
- EMERGING**  
EMERGING OPPORTUNITIES FOR THE PEDESTRIAN ENVIRONMENT  
HS-015 825
- EMPLOYING**  
ANGLE AND SMALL-CAR IMPACT TESTS OF AN ARTICULATED GORE BARRIER EMPLOYING LIGHTWEIGHT CONCRETE ENERGY-ABSORBING CARTRIDGES  
HS-015 792
- ENERGY**  
ANGLE AND SMALL-CAR IMPACT TESTS OF AN ARTICULATED GORE BARRIER EMPLOYING LIGHTWEIGHT CONCRETE ENERGY-ABSORBING CARTRIDGES  
HS-015 792
- AUTOMOBILE COLLISIONS. A MODULE ON ENERGY AND MOMENTUM**  
HS-015 746
- BICYCLES, CARS AND ENERGY**  
HS-015 701
- CRASH ENERGY MANAGEMENT IN SUBCOMPACT AUTOMOBILES**  
HS-015 678
- DEVELOPMENT OF ENERGY ABSORBING AUTOMOTIVE STRUCTURES USING SCALE MODEL TEST TECHNIQUES**  
HS-015 676
- DEVELOPMENT OF ENERGY-ABSORBING SAFETY BELT WEBBING**  
HS-015 687
- ENERGY BASIS FOR COLLISION SEVERITY**  
HS-015 671
- TESTS FOR HAZARDOUS FAILURE OF ENERGY ABSORBING AUTOMOTIVE BUMPER CYLINDERS. REPORT**  
HS-015 802
- THE COMPUTATION OF TEARING ENERGY OF NICKED RUBBER STRIPS IN EXTENSION**  
HS-015 715
- ENFORCEMENT**  
DWI LAW ENFORCEMENT TRAINING PROJECT. EVALUATION AIDS PACKET AND MEDIA LOG  
HS-801 345
- ENGINE**  
DIESEL ENGINE COMPONENT DESIGN USING THE FINITE ELEMENT METHOD AND INTERACTIVE GRAPHICS  
HS-015 727
- ENGINEER**  
FINITE ELEMENT ANALYSIS, AN AUTOMOBILE ENGINEER'S TOOL  
HS-015 728
- ENGINES**  
WHICH AUTOMOTIVE ENGINES IN THE FUTURE?  
HS-015 820
- ENVIRONMENT**  
EMERGING OPPORTUNITIES FOR THE PEDESTRIAN ENVIRONMENT  
HS-015 825
- NEED FOR A PLANNED PEDESTRIAN ENVIRONMENT: THE PHILADELPHIA EXPERIENCE**  
HS-015 827
- PEDESTRIANS IN DOWNTOWN: OBSERVING PEOPLE IN THE BUILT ENVIRONMENT**  
HS-015 828
- ENVIRONMENTAL**  
THE ENVIRONMENTAL QUALITY OF CITY STREETS: THE RESIDENTS' VIEWPOINT  
HS-015 829
- EQUIPPED**  
FACTORS ASSOCIATED WITH SAFETY BELT USE IN 1974 STARTER-INTERLOCK EQUIPPED CARS  
HS-015 815
- ESTIMATED**  
PATTERNS OF TREAD WEAR AND ESTIMATED TREAD LIFE  
HS-015 812

## EVALUATION

AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. ABSTRACT

HS-015 780

AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. FINAL REPORT

HS-015 781

APPLICATION OF FINITE ELEMENT METHODS TO COMPLETE AUTOMOBILE STRUCTURAL DESIGN EVALUATION

HS-015 712

COMPOSITE MATERIALS IN AUTOMOBILE SIDE STRUCTURES--FEASIBILITY EVALUATION. MONTHLY LETTER REPORT NO. 13, JUNE 1974

HS-801 365

COMPOSITE MATERIALS IN AUTOMOBILE SIDE STRUCTURES--FEASIBILITY EVALUATION. MONTHLY LETTER REPORT NO. 14, JULY 1974

HS-801 373

CRASH TEST EVALUATION OF THREE BEAM TRAFFIC BARRIERS

HS-015 796

CRASH TESTS AND EVALUATION OF SINGLE POST HIGHWAY SIGNS. INTERIM REPORT

HS-015 782

DEVELOPMENT AND EVALUATION OF A STRUCTURAL CRASHWORTHINESS SYSTEM FOR A STANDARD SIZE AUTOMOBILE. EXECUTIVE SUMMARY. FINAL REPORT

HS-801 318

DWI LAW ENFORCEMENT TRAINING PROJECT. EVALUATION AIDS PACKET AND MEDIA LOG

HS-801 345

GM-ATD 502 ANTHROPOMORPHIC DUMMY--DEVELOPMENT AND EVALUATION

HS-015 697

INTERRUPTED TIME-SERIES METHODS FOR THE EVALUATION OF TRAFFIC LAW REFORMS

HS-015 705

## EXACT

FIRST RESULTS OF EXACT ACCIDENT DATA ACQUISITION ON SCENE

HS-015 674

## EXAMINATION

EXAMINATION OF ALCOHOL INTOXICATION IN CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A MATHEMATICAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE RESULTS OF CLINICAL EXAMINATION AND BLOOD ALCOHOL

HS-015 784

## EXECUTIVE

DEVELOPMENT AND EVALUATION OF A STRUCTURAL CRASHWORTHINESS SYSTEM FOR A STANDARD SIZE AUTOMOBILE. EXECUTIVE SUMMARY. FINAL REPORT

HS-801 318

## EXPERIMENT

FLEXIBLE WORKING HOURS. A STUDY OF AN EXPERIMENT IN FLEXIBLE WORKING HOURS TO DETERMINE CHANGES IN TRAVEL PATTERNS

HS-015 758

## EXTENDED

THE EFFECT ON TRAFFIC ACCIDENTS OF EXTENDED TRADING HOURS AT HOTELS

HS-015 760

## EXTENSION

THE COMPUTATION OF TEARING ENERGY OF NICKED RUBBER STRIPS IN EXTENSION

HS-015 715

## FABRICATION

DATA FROM FABRICATION OF A STANDARD BENCH VEHICLE SEAT. APPENDIX C

HS-801 385

FABRICATION OF A STANDARD BENCH VEHICLE SEAT. FINAL REPORT

HS-801 384

## FAHRVERHALTEN

INFLUENCES ON THE DRIVING BEHAVIOR OF AUTOMOBILES (EINFLUSSE AUF DAS FAHRVERHALTEN VON KRAFTFAHRZEUGEN)

HS-015 702

## FAILURE

LARGE-TRUCK ACCIDENTS INVOLVING TIRE FAILURE. FINAL REPORT

HS-015 803

TESTS FOR HAZARDOUS FAILURE OF ENERGY ABSORBING AUTOMOTIVE BUMPER CYLINDERS. REPORT

HS-015 802

## FAN

A NEW WET CLUTCH FAN DRIVE SYSTEM

HS-015 821

## FATIGUE

THE USE OF ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS IN THE CALCULATION OF CUMULATIVE FATIGUE DAMAGE

HS-015 714

## FEASIBILITY

COMPOSITE MATERIALS IN AUTOMOBILE SIDE STRUCTURES--FEASIBILITY EVALUATION. MONTHLY LETTER REPORT NO. 13, JUNE 1974

HS-801 365

COMPOSITE MATERIALS IN AUTOMOBILE SIDE STRUCTURES--FEASIBILITY EVALUATION. MONTHLY LETTER REPORT NO. 14, JULY 1974

HS-801 373

FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, SEPTEMBER 1974

HS-801 362

FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, JUNE-JULY 1974

HS-801 363

FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, DECEMBER 1974

HS-801 370

FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, NOVEMBER 1974

HS-801 371

FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, AUGUST 1974

HS-801 372

PRODUCTION FEASIBILITY--CRASHWORTHINESS  
STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS  
REPORT (21ST), 1 MARCH TO 31 MARCH 1974

HS-801 364

PRODUCTION FEASIBILITY--CRASHWORTHINESS  
STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS  
REPORT NO. 22, APRIL 1974

HS-801 378

**FENCE**

VEHICLE-ARRESTING SYSTEM USING CHAIN-LINK  
FENCE

HS-015 793

**FINITE**

AN AXISYMMETRIC FINITE ELEMENT ANALYSIS  
OF THE MECHANICAL AND THERMAL STRESSES in  
brake drums

HS-015 711

APPLICATION OF FINITE ELEMENT METHODS TO  
COMPLETE AUTOMOBILE STRUCTURAL DESIGN  
EVALUATION

HS-015 712

APPLICATION OF GRID SELECTION PROCEDURES  
FOR IMPROVED FINITE ELEMENT STRESS ANALY-  
SIS

HS-015 726

DIESEL ENGINE COMPONENT DESIGN USING THE  
FINITE ELEMENT METHOD AND INTERACTIVE  
GRAPHICS

HS-015 727

FINITE ELEMENT ANALYSIS OF AUTOMOBILE  
STRUCTURES

HS-015 709

FINITE ELEMENT ANALYSIS, AN AUTOMOBILE EN-  
GINEER'S TOOL

HS-015 728

FINITE ELEMENT MODEL DATA CHECKOUT WITH  
INTERACTIVE GRAPHICS

HS-015 731

FINITE ELEMENT STRUCTURAL ANALYSIS AS AP-  
PLIED TO AN AUTOMOTIVE DOOR STRUCTURE

HS-015 710

GENERATION OF FINITE ELEMENT MODELS VIA  
COMPUTER GRAPHICS

HS-015 732

INTERNATIONAL CONFERENCE ON VEHICLE  
STRUCTURAL MECHANICS: FINITE ELEMENT AP-  
PLICATION TO VEHICLE DESIGN, PROCEEDINGS,  
DETROIT, MICHIGAN, MARCH 26-28, 1974

HS-015 706

LARGE DISPLACEMENT, NONLINEAR TRANSIENT  
ANALYSIS BY FINITE ELEMENTS

HS-015 724

THE ROLE OF FINITE DEFORMATION ANALYSIS IN  
PLANE STRESS AND STRAIN FRACTURES

HS-015 722

THE USE OF ELASTIC-PLASTIC FINITE ELEMENT  
ANALYSIS IN THE CALCULATION OF CUMULATIVE  
FATIGUE DAMAGE

HS-015 714

USING INTERACTIVE GRAPHICS FOR THE  
PREPARATION AND MANAGEMENT OF FINITE ELE-  
MENT DATA

HS-015 734

**FIRE**

FIRE IN MOTOR VEHICLE ACCIDENTS

HS-015 817

**FLEXIBILITY**

THE FLEXIBILITY OF A TUBULAR WELDED JOINT  
IN A VEHICLE FRAME

HS-015 730

**FLEXIBLE**

FLEXIBLE WORKING HOURS. A STUDY OF AN EX-  
PERIMENT IN FLEXIBLE WORKING HOURS TO  
DETERMINE CHANGES IN TRAVEL PATTERNS

HS-015 758

**FLORIDA**

CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT. STATE  
OF FLORIDA, 1971 ACCIDENT YEAR

HS-015 741

**FLOW**

INVESTIGATION OF FLOW-DENSITY DISCONTINUI-  
TY AND DUAL-MODE TRAFFIC BEHAVIOR

HS-015 789

**FLUID**

FLUID CRASH SENSOR

HS-015 681

**FORCE**

A FORCE LIMITING SYSTEM ON A THREE-POINT-  
BELT SYSTEM DEPENDING ON CRASH VELOCITY

HS-015 688

**FRACTURES**

THE ROLE OF FINITE DEFORMATION ANALYSIS IN  
PLANE STRESS AND STRAIN FRACTURES

HS-015 722

**FRAME**

THE FLEXIBILITY OF A TUBULAR WELDED JOINT  
IN A VEHICLE FRAME

HS-015 730

**FREEWAY**

DETECTION OF FREEWAY CAPACITY-REDUCING  
INCIDENTS BY TRAFFIC-STREAM MEASUREMENTS

HS-015 785

OPTIMIZATION TECHNIQUES APPLIED TO IMPROV-  
ING FREEWAY OPERATIONS

HS-015 791

STUDY OF DETECTOR RELIABILITY FOR A MO-  
TORIST INFORMATION SYSTEM ON THE GULF  
FREEWAY

HS-015 787

**FRONT**

FRONT END STRUCTURES CRASH RESPONSE  
CHARACTERIZATION

HS-015 677

STATIC ANALYSIS VIA SUBSTRUCTURING OF AN  
EXPERIMENTAL VEHICLE FRONT-END BODY  
STRUCTURE

HS-015 713

May 31, 1975

THE DEVELOPMENT OF AN AIR BAG ON COLLAPSIBLE DASH/PANEL RESTRAINT SYSTEM FOR RIGHT FRONT SEAT OCCUPANTS

HS-015 682

#### FUEL

POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. REPORT TO THE CONGRESS

HS-015 768

THE EFFECT OF SPEED ON TRUCK FUEL CONSUMPTION RATES

HS-015 756

#### FULL

FULL-SCALE EMBANKMENT TESTS AND COMPARISONS WITH A COMPUTER SIMULATION

HS-015 798

PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT (21ST), 1 MARCH TO 31 MARCH 1974

HS-801 364

PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT NO. 22, APRIL 1974

HS-801 378

#### FUTURE

WHICH AUTOMOTIVE ENGINES IN THE FUTURE?

HS-015 820

#### GAS

ELASTO-PLASTIC ANALYSIS OF STRESS IN A GAS-TURBINE WHEEL

HS-015 723

#### GASOLINE

HYDROGEN-ENRICHED GASOLINE FOR AUTOS

HS-015 762

#### GENERATED

APPLICATIONS OF COMPUTER-GENERATED IMAGERY TO DRIVER TRAINING; HIGHWAY RESEARCH, AND DESIGN

HS-015 737

#### GENERATION

GENERATION OF FINITE ELEMENT MODELS VIA COMPUTER GRAPHICS

HS-015 732

#### GM

GM-ATD 502 ANTHROPOMORPHIC DUMMY--DEVELOPMENT AND EVALUATION

HS-015 697

#### GONIOMETER

PROCEDURES AND TECHNIQUES FOR PHOTOMETRIC MEASUREMENT OF GONIOMETER-MOUNTED SAE AND ECE HEADLAMPS

HS-015 800

#### GOOD

AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. ABSTRACT

HS-015 780

AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. FINAL REPORT

HS-015 781

#### GOR

ANGLE AND SMALL-CAR IMPACT TESTS OF AN ARTICULATED GORE BARRIER EMPLOYING LIGHTWEIGHT CONCRETE ENERGY-ABSORBING CARTRIDGES

HS-015 792

#### GRADE

ANALYSIS OF DRIVER REACTION TO WARNING DEVICES AT A HIGH-ACCIDENT RURAL GRADE CROSSING. FINAL REPORT

HS-015 750

#### GRADING

UNIFORM TIRE QUALITY GRADING TREADWEAR. FINAL REPORT

HS-801 315

#### GRAPHICS

DIESEL ENGINE COMPONENT DESIGN USING THE FINITE ELEMENT METHOD AND INTERACTIVE GRAPHICS

HS-015 727

FINITE ELEMENT MODEL DATA CHECKOUT WITH INTERACTIVE GRAPHICS

HS-015 731

GENERATION OF FINITE ELEMENT MODELS VIA COMPUTER GRAPHICS

HS-015 732

USING INTERACTIVE GRAPHICS FOR THE PREPARATION AND MANAGEMENT OF FINITE ELEMENT DATA

HS-015 734

#### GRID

APPLICATION OF GRID SELECTION PROCEDURES FOR IMPROVED FINITE ELEMENT STRESS ANALYSIS

HS-015 726

#### GULF

STUDY OF DETECTOR RELIABILITY FOR A MOTORIST INFORMATION SYSTEM ON THE GULF FREEWAY

HS-015 787

#### HANDLING

THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 1. SUMMARY REPORT. FINAL REPORT

HS-801 323

THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 2. TECHNICAL REPORT. FINAL REPORT

HS-801 324

#### HAZARDOUS

TESTS FOR HAZARDOUS FAILURE OF ENERGY ABSORBING AUTOMOTIVE BUMPER CYLINDERS. REPORT

HS-015 802

#### HEADLAMP

A PROCEDURE FOR THE PHOTOMETRIC DETERMINATION OF HEADLAMP AIM BY ISOLUX CONTOUR MATCHING

HS-015 698

**HEADLAMPS**

PROCEDURES AND TECHNIQUES FOR PHOTOMETRIC MEASUREMENT OF GONIOMETER-MOUNTED SAE AND ECE HEADLAMPS

HS-015 800

**HIGH**

ANALYSIS OF DRIVER REACTION TO WARNING DEVICES AT A HIGH-ACCIDENT RURAL GRADE CROSSING. FINAL REPORT

HS-015 750

**HIGHWAY**

ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SURVEYS OF DRINKING-DRIVING BEHAVIOR: A REVIEW OF THE LITERATURE AND A RECOMMENDED METHODOLOGY

HS-015 823

APPLICATIONS OF COMPUTER-GENERATED IMAGERY TO DRIVER TRAINING; HIGHWAY RESEARCH, AND DESIGN

HS-015 737

AUTOMOBILES AND HIGHWAY CRASH ATTENUATORS: SYSTEM DESIGN CONSIDERATIONS

HS-015 794

CRASH TESTS AND EVALUATION OF SINGLE POST HIGHWAY SIGNS. INTERIM REPORT

HS-015 782

HIGHWAY SAFETY PROGRAM MANUAL. VOL. 7. TRAFFIC COURTS

HS-801 349

PERFORMANCE OF VOLUNTEER MONITORS USING CITIZENS BAND RADIO FOR A HIGHWAY COMMUNICATIONS SERVICE

HS-015 786

SIMULATION: ITS ROLE IN DRIVER RESEARCH AND HIGHWAY DESIGN. VOL. 8

HS-015 736

THE EFFORTS OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION IN THE DEVELOPMENT OF ADVANCED PASSIVE PROTECTION SYSTEMS AND CHILD RESTRAINT SYSTEMS

HS-015 686

THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY

HS-015 694

USE OF MATHEMATICAL SIMULATIONS TO DEVELOP SAFER HIGHWAY DESIGN CRITERIA

HS-015 739

**HIGHWAYS**

ALGORITHM FOR A REAL-TIME ADVISORY SIGN CONTROL SYSTEM FOR URBAN HIGHWAYS

HS-015 790

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS. PT. 7: TRAFFIC CONTROLS FOR SCHOOL AREAS

HS-015 822

**HINTS**

TRAILER POINTERS AND DRIVING HINTS FOR PASSENGER CAR OWNERS

HS-015 761

**HOTELS**

THE EFFECT ON TRAFFIC ACCIDENTS OF EXTENDED TRADING HOURS AT HOTELS

HS-015 760

**HOURS**

FLEXIBLE WORKING HOURS. A STUDY OF AN EXPERIMENT IN FLEXIBLE WORKING HOURS TO DETERMINE CHANGES IN TRAVEL PATTERNS

HS-015 758

THE EFFECT ON TRAFFIC ACCIDENTS OF EXTENDED TRADING HOURS AT HOTELS

HS-015 760

**HSRI**

DISCUSSION (THE HSRI DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY)

HS-015 695

**HUMAN**

HUMAN CHEST IMPACT PROTECTION CRITERIA

HS-015 696

HUMAN VOLUNTEER AND ANTHROPOMORPHIC DUMMY TESTS OF GENERAL MOTORS DRIVER AIR CUSHION SYSTEM

HS-015 684

THE USE OF HUMAN SUBJECTS IN HUMAN FACTORS RESEARCH

HS-015 704

**HYBRID**

AN INTERACTIVE HYBRID TECHNIQUE FOR CRASHWORTHY DESIGN OF COMPLEX VEHICULAR STRUCTURAL SYSTEMS

HS-015 717

DISCUSSION (THE HSRI DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY)

HS-015 695

THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY

HS-015 694

**HYDRAULIC**

VEHICLE BRAKING SYSTEMS TEST PROCEDURE--HYDRAULIC BRAKES. FINAL REPORT

HS-801 308

**HYDROGEN**

HYDROGEN-ENRICHED GASOLINE FOR AUTOS

HS-015 762

**HYDROPLANING**

TIRE DEFORMATION DURING DYNAMIC HYDROPLANING

HS-015 755

**IDENTIFICATION**

IDENTIFICATION OF COUNTERMEASURES FOR THE YOUTH CRASH PROBLEM RELATED TO ALCOHOL. FINAL REPORT

HS-801 344



May 31, 1975

#### **IMAGERY**

APPLICATIONS OF COMPUTER-GENERATED  
IMAGERY TO DRIVER TRAINING; HIGHWAY  
RESEARCH, AND DESIGN

HS-015 737

#### **IMPACT**

ANGLE AND SMALL-CAR IMPACT TESTS OF AN AR-  
TICULATED GORE BARRIER EMPLOYING  
LIGHTWEIGHT CONCRETE ENERGY-ABSORBING  
CARTRIDGES

HS-015 792

HUMAN CHEST IMPACT PROTECTION CRITERIA

HS-015 696

THE IMPACT OF DRIVER IMPROVEMENT: DO WE  
REALLY WANT TO KNOW?

HS-015 703

#### **IMPLICATIONS**

HOW DRIVERS PREVENTED FROM DRIVING WOULD  
REACH WORK: IMPLICATIONS FOR PENALTIES

HS-015 816

#### **IMPROVEMENT**

IMPROVEMENT IN DYNAMIC CHARACTERISTICS OF  
AUTOMOBILE SUSPENSION SYSTEMS. PT. 2. THREE-  
MASS SYSTEMS

HS-015 804

POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY  
IMPROVEMENT. REPORT TO THE CONGRESS

HS-015 768

THE IMPACT OF DRIVER IMPROVEMENT: DO WE  
REALLY WANT TO KNOW?

HS-015 703

#### **IMPROVING**

OPTIMIZATION TECHNIQUES APPLIED TO IMPROV-  
ING FREEWAY OPERATIONS

HS-015 791

#### **INCENTIVE**

AN EVALUATION OF CALIFORNIA'S "GOOD  
DRIVER" INCENTIVE PROGRAM. ABSTRACT

HS-015 780

AN EVALUATION OF CALIFORNIA'S "GOOD  
DRIVER" INCENTIVE PROGRAM. FINAL REPORT

HS-015 781

#### **INCIDENTS**

DETECTION OF FREEWAY CAPACITY-REDUCING  
INCIDENTS BY TRAFFIC-STREAM MEASUREMENTS

HS-015 785

#### **INCONVENIENCES**

SOURCES AND REMEDIES FOR RESTRAINT SYSTEM  
DISCOMFORT AND INCONVENIENCES. FINAL  
BRIEFING

HS-801 374

#### **INDUCED**

TEST SLED SIMULATION OF CRASH INDUCED YAW  
AND PITCH

HS-015 693

#### **INEXPENSIVE**

AN INEXPENSIVE AUTOMOBILE CRASH RECORDER

HS-015 673

#### **INFLATABLE**

INFLATABLE BELT DEVELOPMENT FOR SUBCOM-  
PACT CAR PASSENGERS. PROGRESS REPORT, SEP-  
TEMBER 1974

HS-801 369

#### **INFLATED**

COMPRESSION OF AN INFLATED TUBE BETWEEN  
RIGID SURFACES AS AN ELEMENTARY TIRE  
MECHANICS MODEL

HS-015 810

#### **INFLUENCES**

INFLUENCES ON THE DRIVING BEHAVIOR OF AU-  
TOMOBILES (EINFLUSSE AUF DAS FAHRVERHAL-  
TEN VON KRAFTFAHRZEUGEN)

HS-015 702

#### **INFORMATION**

STUDY OF DETECTOR RELIABILITY FOR A MO-  
TORIST INFORMATION SYSTEM ON THE GULF  
FREEWAY

HS-015 787

TRAFFIC INFORMATION SYSTEM. PHASE 3. FINAL  
REPORT

HS-015 776

#### **INITIATIVE**

ROAD SAFETY AND THE CONSUMER. A MAJOR  
NEW RESEARCH INITIATIVE

HS-015 818

#### **INJURY**

DRIVER INJURY IN AUTOMOBILE ACCIDENTS IN-  
VOLVING CERTAIN CAR MODELS: AN UPDATE

HS-015 668

INJURY ASSESSMENT OF BELTED CADAVERS.  
PROGRESS REPORT NO. 4, OCTOBER 1974

HS-801 375

INJURY ASSESSMENT OF BELTED CADAVERS  
PROGRESS REPORT NO. 3, SEPTEMBER 1974

HS-801 376

#### **INSTITUTE**

THE HIGHWAY SAFETY RESEARCH INSTITUTE  
DUMMY COMPARED WITH GENERAL MOTORS  
BIOFIDELITY RECOMMENDATIONS AND THE  
HYBRID 2 DUMMY

HS-015 694

#### **INSURANCE**

AUTOMOBILE INSURANCE LOSSES COLLISION  
COVERAGES. RELATIONSHIPS BETWEEN LOSSES  
AND VEHICLE DENSITY, 1972 AND 1973 MODELS

HS-015 735

#### **INTERACTIVE**

AN INTERACTIVE HYBRID TECHNIQUE FOR  
CRASHWORTHY DESIGN OF COMPLEX VEHICULAR  
STRUCTURAL SYSTEMS

HS-015 717

DIESEL ENGINE COMPONENT DESIGN USING THE  
FINITE ELEMENT METHOD AND INTERACTIVE  
GRAPHICS

HS-015 727

FINITE ELEMENT MODEL DATA CHECKOUT WITH  
INTERACTIVE GRAPHICS

HS-015 731

- USING INTERACTIVE GRAPHICS FOR THE PREPARATION AND MANAGEMENT OF FINITE ELEMENT DATA**  
HS-015 734
- INTERLOCK**  
FACTORS ASSOCIATED WITH SAFETY BELT USE IN 1974 STARTER-INTERLOCK EQUIPPED CARS  
HS-015 815
- INTERNATIONAL**  
INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, TROY, MICHIGAN, JULY 10-12, 1974  
HS-015 670  
INTERNATIONAL CONFERENCE ON VEHICLE STRUCTURAL MECHANICS: FINITE ELEMENT APPLICATION TO VEHICLE DESIGN, PROCEEDINGS, DETROIT, MICHIGAN, MARCH 26-28, 1974  
HS-015 706
- INTERRUPTED**  
INTERRUPTED TIME-SERIES METHODS FOR THE EVALUATION OF TRAFFIC LAW REFORMS  
HS-015 705
- INTERSECTIONS**  
PEDESTRIAN BEHAVIOR AT SIGNALISED INTERSECTIONS  
HS-015 765
- INTOXICATION**  
EXAMINATION OF ALCOHOL INTOXICATION IN CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A MATHEMATICAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE RESULTS OF CLINICAL EXAMINATION AND BLOOD ALCOHOL  
HS-015 784
- INVESTIGATION**  
AN INVESTIGATION OF FACTORS AFFECTING THE USE OF BUSES BY BOTH ELDERLY AND AMBULANT DISABLED PERSONS  
HS-015 669  
INVESTIGATION OF FLOW-DENSITY DISCONTINUITY AND DUAL-MODE TRAFFIC BEHAVIOR  
HS-015 789
- INVESTIGATIONS**  
SCHWINGUNGSUNTERSUCHUNGEN AN EINER PKW-KAROSSERIE (INVESTIGATIONS INTO THE VIBRATIONS OF AN AUTOMOBILE BODY)  
HS-015 805  
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE CRASHWORTHINESS OF SMALL CARS  
HS-015 679
- ISOLUX**  
A PROCEDURE FOR THE PHOTOMETRIC DETERMINATION OF HEADLAMP AIM BY ISOLUX CONTOUR MATCHING  
HS-015 698
- JOINT**  
THE FLEXIBILITY OF A TUBULAR WELDED JOINT IN A VEHICLE FRAME  
HS-015 730
- KAROSSERIE**  
SCHWINGUNGSUNTERSUCHUNGEN AN EINER PKW-KAROSSERIE (INVESTIGATIONS INTO THE VIBRATIONS OF AN AUTOMOBILE BODY)  
HS-015 805
- KRAFTFAHRZEUGEN**  
INFLUENCES ON THE DRIVING BEHAVIOR OF AUTOMOBILES (EINFLUSSE AUF DAS FAHRVERHALTEN VON KRAFTFAHRZEUGEN)  
HS-015 702
- LARGE**  
LARGE DISPLACEMENT, NONLINEAR TRANSIENT ANALYSIS BY FINITE ELEMENTS  
HS-015 724  
LARGE-TRUCK ACCIDENTS INVOLVING TIRE FAILURE. FINAL REPORT  
HS-015 803
- LAW**  
A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY PREPARED ON RULES OF THE ROAD UNIFORMITY IN THE TRAFFIC LAWS OF THE SEVERAL STATES  
HS-820 262  
DWI LAW ENFORCEMENT TRAINING PROJECT. EVALUATION AIDS PACKET AND MEDIA LOG  
HS-801 345  
INTERRUPTED TIME-SERIES METHODS FOR THE EVALUATION OF TRAFFIC LAW REFORMS  
HS-015 705
- LAWS**  
A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY PREPARED ON RULES OF THE ROAD UNIFORMITY IN THE TRAFFIC LAWS OF THE SEVERAL STATES  
HS-820 262
- LEGAL**  
DRINKING AND DRIVING AFTER IT'S LEGAL TO DRINK AT 18  
HS-015 747
- LEVEL**  
TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS. VOL. 1-RESEARCH FINDINGS. FINAL REPORT  
HS-801 334  
TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS: INTERIM REPORT I. VOL. 2--APPENDICES.  
HS-801 335
- LIFE**  
PATTERNS OF TREAD WEAR AND ESTIMATED TREAD LIFE  
HS-015 812
- LIGHTWEIGHT**  
ANGLE AND SMALL-CAR IMPACT TESTS OF AN ARTICULATED GORE BARRIER EMPLOYING LIGHTWEIGHT CONCRETE ENERGY-ABSORBING CARTRIDGES  
HS-015 792

- LIMIT**  
ACCIDENT STUDY RAISES QUESTIONS ON 55 MPH  
NATIONAL SPEED LIMIT  
HS-015 764
- LIMITING**  
A FORCE LIMITING SYSTEM ON A THREE-POINT-  
BELT SYSTEM DEPENDING ON CRASH VELOCITY  
HS-015 688
- LINK**  
VEHICLE-ARRESTING SYSTEM USING CHAIN-LINK  
FENCE  
HS-015 793
- LITERATURE**  
ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SUR-  
VEYS OF DRINKING-DRIVING BEHAVIOR: A  
REVIEW OF THE LITERATURE AND A RECOM-  
MENDED METHODOLOGY  
HS-015 823
- LOADS**  
STIFFNESS ANALYSIS OF SHEET METAL SHELLS  
UNDER CONCENTRATED LOADS  
HS-015 725
- LOCATION**  
AN INTRODUCTION TO SCALE MODEL TESTING TO  
DETERMINE AIR CUSHION CRASH SENSOR LOCA-  
TION  
HS-015 691
- LOG**  
DWI LAW ENFORCEMENT TRAINING PROJECT.  
EVALUATION AIDS PACKET AND MEDIA LOG  
HS-801 345
- LOSSES**  
AUTOMOBILE INSURANCE LOSSES COLLISION  
COVERAGES. RELATIONSHIPS BETWEEN LOSSES  
AND VEHICLE DENSITY, 1972 AND 1973 MODELS  
HS-015 735
- MAJOR**  
ROAD SAFETY AND THE CONSUMER. A MAJOR  
NEW RESEARCH INITIATIVE  
HS-015 818
- MANAGEMENT**  
CRASH ENERGY MANAGEMENT IN SUBCOMPACT  
AUTOMOBILES  
HS-015 678  
USING INTERACTIVE GRAPHICS FOR THE  
PREPARATION AND MANAGEMENT OF FINITE ELE-  
MENT DATA  
HS-015 734
- MANUAL**  
HIGHWAY SAFETY PROGRAM MANUAL. VOL. 7.  
TRAFFIC COURTS  
HS-801 349  
MANUAL ON UNIFORM TRAFFIC CONTROL  
DEVICES FOR STREETS AND HIGHWAYS. PT. 7:  
TRAFFIC CONTROLS FOR SCHOOL AREAS  
HS-015 822  
USER'S MANUAL FOR UCIN VEHICLE-OCCUPANT  
CRASH-STUDY MODEL  
HS-015 769
- MASS**  
A MODAL SYNTHESIS TECHNIQUE FOR DETERMIN-  
ING DYNAMIC PROPERTIES FOR A STRUCTURE FOR  
MASS AND STIFFNESS CHANGES  
HS-015 719
- IMPROVEMENT IN DYNAMIC CHARACTERISTICS OF  
AUTOMOBILE SUSPENSION SYSTEMS. PT. 2. THREE-  
MASS SYSTEMS**  
HS-015 804
- MATCHING**  
A PROCEDURE FOR THE PHOTOMETRIC DETER-  
MINATION OF HEADLAMP AIM BY ISOLUX CON-  
TOUR MATCHING  
HS-015 698
- MATERIALS**  
COMPOSITE MATERIALS IN AUTOMOBILE SIDE  
STRUCTURES--FEASIBILITY EVALUATION.  
MONTHLY LETTER REPORT NO. 13, JUNE 1974  
HS-801 365  
COMPOSITE MATERIALS IN AUTOMOBILE SIDE  
STRUCTURES--FEASIBILITY EVALUATION.  
MONTHLY LETTER REPORT NO. 14, JULY 1974  
HS-801 373
- MATHEMATICAL**  
EXAMINATION OF ALCOHOL INTOXICATION IN  
CASES OF SUSPECTED DRUNKEN DRIVERS. 2. A  
MATHEMATICAL ANALYSIS OF THE RELATIONSHIP  
BETWEEN THE RESULTS OF CLINICAL EXAMINA-  
TION AND BLOOD ALCOHOL  
HS-015 784  
USE OF MATHEMATICAL SIMULATIONS TO  
DEVELOP SAFER HIGHWAY DESIGN CRITERIA  
HS-015 739
- MATRICES**  
PERFORMANCE MATRICES OF FOUR RESTRAINT  
SYSTEMS  
HS-015 689
- MEASUREMENT**  
PROCEDURES AND TECHNIQUES FOR PHOTOMET-  
RIC MEASUREMENT OF GONIOMETER-MOUNTED  
SAE AND ECE HEADLAMPS  
HS-015 800
- MEASUREMENTS**  
DETECTION OF FREEWAY CAPACITY-REDUCING  
INCIDENTS BY TRAFFIC-STREAM MEASUREMENTS  
HS-015 785
- MEASURING**  
DESIGN OF DENSITY-MEASURING SYSTEMS FOR  
ROADWAYS  
HS-015 788
- MECHANICAL**  
AN AXISYMMETRIC FINITE ELEMENT ANALYSIS  
OF THE MECHANICAL AND THERMAL STRESSES in  
brake drums  
HS-015 711
- MECHANICS**  
COMPRESSION OF AN INFLATED TUBE BETWEEN  
RIGID SURFACES AS AN ELEMENTARY TIRE  
MECHANICS MODEL  
HS-015 810

INTERNATIONAL CONFERENCE ON VEHICLE  
STRUCTURAL MECHANICS: FINITE ELEMENT AP-  
PLICATION TO VEHICLE DESIGN, PROCEEDINGS,  
DETROIT, MICHIGAN, MARCH 26-28, 1974

HS-015 706

**MEDIA**

DWI LAW ENFORCEMENT TRAINING PROJECT.  
EVALUATION AIDS PACKET AND MEDIA LOG

HS-801 345

**MEDIAN**

DEVELOPMENT OF A NEW MEDIAN BARRIER TER-  
MINAL

HS-015 795

**METAL**

STIFFNESS ANALYSIS OF SHEET METAL SHELLS  
UNDER CONCENTRATED LOADS

HS-015 725

**METHOD**

DIESEL ENGINE COMPONENT DESIGN USING THE  
FINITE ELEMENT METHOD AND INTERACTIVE  
GRAPHICS

HS-015 727

THE TRAFFIC CONFLICTS TECHNIQUE: AN AC-  
CIDENT PREDICTION METHOD

HS-015 801

**METHODOLOGY**

ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SUR-  
VEYS OF DRINKING-DRIVING BEHAVIOR: A  
REVIEW OF THE LITERATURE AND A RECOM-  
MENDED METHODOLOGY

HS-015 823

**METHODS**

APPLICATION OF FINITE ELEMENT METHODS TO  
COMPLETE AUTOMOBILE STRUCTURAL DESIGN  
EVALUATION

HS-015 712

INTERRUPTED TIME-SERIES METHODS FOR THE  
EVALUATION OF TRAFFIC LAW REFORMS

HS-015 705

**MEXICO**

CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT. STATE  
OF NEW MEXICO. 1972 ACCIDENT YEAR

HS-015 808

**MICHIGAN**

INTERNATIONAL CONFERENCE ON OCCUPANT  
PROTECTION (3RD) PROCEEDINGS, TROY,  
MICHIGAN, JULY 10-12, 1974

HS-015 670

INTERNATIONAL CONFERENCE ON VEHICLE  
STRUCTURAL MECHANICS: FINITE ELEMENT AP-  
PLICATION TO VEHICLE DESIGN, PROCEEDINGS,  
DETROIT, MICHIGAN, MARCH 26-28, 1974

HS-015 706

**MINNESOTA**

CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT. STATE  
OF MINNESOTA. 1972 ACCIDENT YEAR

HS-015 772

**MISSOURI**

CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT. STATE  
OF MISSOURI. 1972 ACCIDENT YEAR

HS-015 773

CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT. STATE  
OF MISSOURI. 1971 ACCIDENT YEAR

HS-015 807

**MODAL**

A MODAL SYNTHESIS TECHNIQUE FOR DETERMIN-  
ING DYNAMIC PROPERTIES FOR A STRUCTURE FOR  
MASS AND STIFFNESS CHANGES

HS-015 719

**MODE**

INVESTIGATION OF FLOW-DENSITY DISCONTINU-  
ITY AND DUAL-MODE TRAFFIC BEHAVIOR

HS-015 789

**MODEL**

A TECHNIQUE FOR CONNECTING BEAM ELEMENTS  
TO A PLATE MODEL OF A COMPLICATED BOX SEC-  
TION

HS-015 729

AN INTRODUCTION TO SCALE MODEL TESTING TO  
DETERMINE AIR CUSHION CRASH SENSOR LOCA-  
TION

HS-015 691

COMPRESSION OF AN INFLATED TUBE BETWEEN  
RIGID SURFACES AS AN ELEMENTARY TIRE  
MECHANICS MODEL

HS-015 810

DEVELOPMENT OF ENERGY ABSORBING AUTOMO-  
TIVE STRUCTURES USING SCALE MODEL TEST  
TECHNIQUES

HS-015 676

FINITE ELEMENT MODEL DATA CHECKOUT WITH  
INTERACTIVE GRAPHICS

HS-015 731

USER'S MANUAL FOR UCIN VEHICLE-OCCUPANT  
CRASH-STUDY MODEL

HS-015 769

**MODELING**

SCALE MODELING OF VEHICLE CRASHES--  
TECHNIQUES, APPLICABILITY, AND ACCURACY;  
COST EFFECTIVENESS

HS-015 692

**MODELLING**

DESTINATION CHOICE MODELLING AND THE DIS-  
AGGREGATE ANALYSIS OF URBAN TRAVEL  
BEHAVIOR. FINAL REPORT

HS-015 751

**MODELS**

AUTOMOBILE INSURANCE LOSSES COLLISION  
COVERAGES. RELATIONSHIPS BETWEEN LOSSES  
AND VEHICLE DENSITY, 1972 AND 1973 MODELS

HS-015 735

DRIVER INJURY IN AUTOMOBILE ACCIDENTS IN-  
VOLVING CERTAIN CAR MODELS: AN UPDATE

HS-015 668

May 31, 1975

- GENERATION OF FINITE ELEMENT MODELS VIA  
COMPUTER GRAPHICS  
HS-015 732
- MODIFICATION**  
BELT RETRACTOR TESTING WITH STANDARD  
VEHICLE SEAT. APPENDIX D. MODIFICATION 1.  
HS-801 386
- MODULE**  
AUTOMOBILE COLLISIONS. A MODULE ON ENER-  
GY AND MOMENTUM  
HS-015 746
- MOIRE**  
CONTOURING THE TIRE SIDEWALL WITH MOIRE  
HS-015 811
- MOMENTUM**  
AUTOMOBILE COLLISIONS. A MODULE ON ENER-  
GY AND MOMENTUM  
HS-015 746
- MONITORS**  
PERFORMANCE OF VOLUNTEER MONITORS USING  
CITIZENS BAND RADIO FOR A HIGHWAY COMMU-  
NICATIONS SERVICE  
HS-015 786
- MONTANA**  
CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT. STATE  
OF MONTANA. 1972 ACCIDENT YEAR  
HS-015 774
- MOTOR**  
FIRE IN MOTOR VEHICLE ACCIDENTS  
HS-015 817  
POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY  
IMPROVEMENT. REPORT TO THE CONGRESS  
HS-015 768
- MOTORIST**  
STUDY OF DETECTOR RELIABILITY FOR A MO-  
TORIST INFORMATION SYSTEM ON THE GULF  
FREEWAY  
HS-015 787
- MOTORS**  
DISCUSSION (THE HSRI DUMMY COMPARED WITH  
GENERAL MOTORS BIOFIDELITY RECOMMENDA-  
TIONS AND THE HYBRID 2 DUMMY)  
HS-015 695  
HUMAN VOLUNTEER AND ANTHROPOMORPHIC  
DUMMY TESTS OF GENERAL MOTORS DRIVER AIR  
CUSHION SYSTEM  
HS-015 684  
THE HIGHWAY SAFETY RESEARCH INSTITUTE  
DUMMY COMPARED WITH GENERAL MOTORS  
BIOFIDELITY RECOMMENDATIONS AND THE  
HYBRID 2 DUMMY  
HS-015 694
- MOUNTED**  
PROCEDURES AND TECHNIQUES FOR PHOTOMET-  
RIC MEASUREMENT OF GONIOMETER-MOUNTED  
SAE AND ECE HEADLAMPS  
HS-015 800
- MULTIPURPOSE**  
A PROPOSED NEW NATIONAL SYSTEM FOR COL-  
LECTING MULTIPURPOSE ACCIDENT DATA: SIR  
HS-015 757
- MULTISECTIONED**  
ANALYSIS OF THE WEAR OF MULTISECTIONED  
TIRE TREADS  
HS-015 813
- NASTRAN**  
NASTRAN FOR DYNAMIC ANALYSIS OF VEHICLE  
SYSTEMS  
HS-015 716  
NASTRAN PLOTTING AT A REMOTE TERMINAL  
HS-015 733  
POWER SPECTRAL DENSITY ANALYSIS OF VEHI-  
CLE VIBRATION USING THE NASTRAN COMPUTER  
PROGRAM  
HS-015 718
- NATIONAL**  
A PROPOSED NEW NATIONAL SYSTEM FOR COL-  
LECTING MULTIPURPOSE ACCIDENT DATA: SIR  
HS-015 757  
ACCIDENT STUDY RAISES QUESTIONS ON 55 MPH  
NATIONAL SPEED LIMIT  
HS-015 764  
THE EFFORTS OF THE NATIONAL HIGHWAY TRAF-  
FIC SAFETY ADMINISTRATION IN THE DEVELOP-  
MENT OF ADVANCED PASSIVE PROTECTION  
SYSTEMS AND CHILD RESTRAINT SYSTEMS  
HS-015 686
- NEED**  
NEED FOR A PLANNED PEDESTRIAN ENVIRON-  
MENT: THE PHILADELPHIA EXPERIENCE  
HS-015 827
- NEVADA**  
CONVERSION OF STATE ACCIDENT DATA TO  
UNIFORM ACCIDENT DATA TAPE FORMAT. STATE  
OF NEVADA. 1972 ACCIDENT YEAR  
HS-015 809
- NICKED**  
THE COMPUTATION OF TEARING ENERGY OF  
NICKED RUBBER STRIPS IN EXTENSION  
HS-015 715
- NISSAN**  
STUDY ON AIR BAG SYSTEMS FOR NISSAN SMALL-  
SIZED CARS  
HS-015 683
- NONLINEAR**  
LARGE DISPLACEMENT, NONLINEAR TRANSIENT  
ANALYSIS BY FINITE ELEMENTS  
HS-015 724  
SURVEY OF SOLUTION PROCEDURES FOR NON-  
LINEAR STATIC AND DYNAMIC ANALYSES  
HS-015 707
- OBSERVING**  
PEDESTRIANS IN DOWNTOWN: OBSERVING PEOPLE  
IN THE BUILT ENVIRONMENT  
HS-015 828

**OCCUPANT**

IN-DEPTH ACCIDENT DATA AND OCCUPANT PROTECTION--A STATISTICAL POINT OF VIEW

HS-015 675

INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, TROY, MICHIGAN, JULY 10-12, 1974

HS-015 670

USER'S MANUAL FOR UCIN VEHICLE-OCCUPANT CRASH-STUDY MODEL

HS-015 769

**OCCUPANTS**

THE DEVELOPMENT OF AN AIR BAG ON COLLAPSIBLE DASHBOARD RESTRAINT SYSTEM FOR RIGHT FRONT SEAT OCCUPANTS

HS-015 682

**OKLAHOMA**

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF OKLAHOMA. 1971 ACCIDENT YEAR

HS-015 806

**ONTARIO**

DRINKING-DRIVING IN THE PROVINCE OF ONTARIO

HS-015 824

**OPERATIONS**

OPTIMIZATION TECHNIQUES APPLIED TO IMPROVING FREEWAY OPERATIONS

HS-015 791

**OPPORTUNITIES**

EMERGING OPPORTUNITIES FOR THE PEDESTRIAN ENVIRONMENT

HS-015 825

**OPTIMIZATION**

OPTIMIZATION TECHNIQUES APPLIED TO IMPROVING FREEWAY OPERATIONS

HS-015 791

**ORIENTED**

A USER-ORIENTED PROGRAM FOR CRASH DYNAMICS

HS-015 721

**OVERVIEW**

A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY PREPARED ON RULES OF THE ROAD UNIFORMITY IN THE TRAFFIC LAWS OF THE SEVERAL STATES

HS-820 262

**OWNERS**

TRAILER POINTERS AND DRIVING HINTS FOR PASSENGER CAR OWNERS

HS-015 761

**PACKET**

DWI LAW ENFORCEMENT TRAINING PROJECT. EVALUATION AIDS PACKET AND MEDIA LOG

HS-801 345

**PASSENGER**

THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 1. SUMMARY REPORT. FINAL REPORT

HS-801 323

THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 2. TECHNICAL REPORT. FINAL REPORT

HS-801 324

TRAILER POINTERS AND DRIVING HINTS FOR PASSENGER CAR OWNERS

HS-015 761

**PASSENGERS**

INFLATABLE BELT DEVELOPMENT FOR SUBCOMPACT CAR PASSENGERS. PROGRESS REPORT, SEPTEMBER 1974

HS-801 369

**PASSIVE**

THE EFFORTS OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION IN THE DEVELOPMENT OF ADVANCED PASSIVE PROTECTION SYSTEMS AND CHILD RESTRAINT SYSTEMS

HS-015 686

**PATTERNS**

FLEXIBLE WORKING HOURS. A STUDY OF AN EXPERIMENT IN FLEXIBLE WORKING HOURS TO DETERMINE CHANGES IN TRAVEL PATTERNS

HS-015 758

PATTERNS OF TREAD WEAR AND ESTIMATED TREAD LIFE

HS-015 812

**PEDESTRIAN**

EMERGING OPPORTUNITIES FOR THE PEDESTRIAN ENVIRONMENT

HS-015 825

NEED FOR A PLANNED PEDESTRIAN ENVIRONMENT: THE PHILADELPHIA EXPERIENCE

HS-015 827

PEDESTRIAN BEHAVIOR AT SIGNALISED INTERSECTIONS

HS-015 765

PEDESTRIAN CIRCULATION PLANNING: PRINCIPLES, PROCEDURES, PROTOTYPES

HS-015 826

**PEDESTRIANS**

PEDESTRIANS IN DOWNTOWN: OBSERVING PEOPLE IN THE BUILT ENVIRONMENT

HS-015 828

**PENALTIES**

HOW DRIVERS PREVENTED FROM DRIVING WOULD REACH WORK: IMPLICATIONS FOR PENALTIES

HS-015 816

**PEOPLE**

PEDESTRIANS IN DOWNTOWN: OBSERVING PEOPLE IN THE BUILT ENVIRONMENT

HS-015 828

- ALL ABOUT CATALYTIC CONVERTERS. HOW THEY WORK AND WHAT YOU CAN EXPECT IN PERFORMANCE  
HS-015 767
- PERFORMANCE MATRICES OF FOUR RESTRAINT SYSTEMS  
HS-015 689
- PERFORMANCE OF VOLUNTEER MONITORS USING CITIZENS BAND RADIO FOR A HIGHWAY COMMUNICATIONS SERVICE  
HS-015 786
- PERSONS**  
AN INVESTIGATION OF FACTORS AFFECTING THE USE OF BUSES BY BOTH ELDERLY AND AMBULANT DISABLED PERSONS  
HS-015 669
- PHILADELPHIA**  
NEED FOR A PLANNED PEDESTRIAN ENVIRONMENT: THE PHILADELPHIA EXPERIENCE  
HS-015 827
- PHOTOMETRIC**  
A PROCEDURE FOR THE PHOTOMETRIC DETERMINATION OF HEADLAMP AIM BY ISOLUX CONTOUR MATCHING  
HS-015 698
- PROCEDURES AND TECHNIQUES FOR PHOTOMETRIC MEASUREMENT OF GONIOMETER-MOUNTED SAE AND ECE HEADLAMPS  
HS-015 800
- PITCH**  
TEST SLED SIMULATION OF CRASH INDUCED YAW AND PITCH  
HS-015 693
- PKW**  
SCHWINGUNGSUNTERSUCHUNGEN AN EINER PKW-KAROSSERIE (INVESTIGATIONS INTO THE VIBRATIONS OF AN AUTOMOBILE BODY)  
HS-015 805
- PLANE**  
THE ROLE OF FINITE DEFORMATION ANALYSIS IN PLANE STRESS AND STRAIN FRACTURES  
HS-015 722
- PLANNED**  
NEED FOR A PLANNED PEDESTRIAN ENVIRONMENT: THE PHILADELPHIA EXPERIENCE  
HS-015 827
- PLANNING**  
PEDESTRIAN CIRCULATION PLANNING: PRINCIPLES, PROCEDURES, PROTOTYPES  
HS-015 826
- PLASTIC**  
ELASTIC-PLASTIC PLATE BENDING WITH CONSTANT CURVATURE ELEMENTS  
HS-015 708
- ELASTO-PLASTIC ANALYSIS OF STRESS IN A GAS-TURBINE WHEEL  
HS-015 723
- FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, SEPTEMBER 1974  
HS-801 362
- FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, JUNE-JULY 1974  
HS-801 363
- FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, DECEMBER 1974  
HS-801 370
- FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, NOVEMBER 1974  
HS-801 371
- FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, AUGUST 1974  
HS-801 372
- THE USE OF ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS IN THE CALCULATION OF CUMULATIVE FATIGUE DAMAGE  
HS-015 714
- PLATE**  
A TECHNIQUE FOR CONNECTING BEAM ELEMENTS TO A PLATE MODEL OF A COMPLICATED BOX SECTION  
HS-015 729
- ELASTIC-PLASTIC PLATE BENDING WITH CONSTANT CURVATURE ELEMENTS  
HS-015 708
- PLOTTING**  
NASTRAN PLOTTING AT A REMOTE TERMINAL  
HS-015 733
- POINTERS**  
TRAILER POINTERS AND DRIVING HINTS FOR PASSENGER CAR OWNERS  
HS-015 761
- POLES**  
A BREAKAWAY CONCEPT FOR TIMBER UTILITY POLES  
HS-015 799
- POST**  
CRASH TESTS AND EVALUATION OF SINGLE POST HIGHWAY SIGNS. INTERIM REPORT  
HS-015 782
- POTENTIAL**  
POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. REPORT TO THE CONGRESS  
HS-015 768
- POWER**  
POWER SPECTRAL DENSITY ANALYSIS OF VEHICLE VIBRATION USING THE NASTRAN COMPUTER PROGRAM  
HS-015 718
- PRECOLLISION**  
BARBI, A NEW RADAR CONCEPT FOR PRECOLLISION SENSING  
HS-015 680
- PREDICTION**  
THE TRAFFIC CONFLICTS TECHNIQUE: AN ACCIDENT PREDICTION METHOD  
HS-015 801

**PREPARATION**

USING INTERACTIVE GRAPHICS FOR THE PREPARATION AND MANAGEMENT OF FINITE ELEMENT DATA

HS-015 734

**PREPARED**

A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY PREPARED ON RULES OF THE ROAD UNIFORMITY IN THE TRAFFIC LAWS OF THE SEVERAL STATES

HS-820 262

**PREVENTED**

HOW DRIVERS PREVENTED FROM DRIVING WOULD REACH WORK: IMPLICATIONS FOR PENALTIES

HS-015 816

**PRINCIPLES**

PEDESTRIAN CIRCULATION PLANNING: PRINCIPLES, PROCEDURES, PROTOTYPES

HS-015 826

**PROBLEM**

IDENTIFICATION OF COUNTERMEASURES FOR THE YOUTH CRASH PROBLEM RELATED TO ALCOHOL. FINAL REPORT

HS-801 344

**PROBLEMS**

THE USE OF CONDENSATION TECHNIQUES FOR SOLVING DYNAMICS PROBLEMS

HS-015 720

**PROCEDURE**

A PROCEDURE FOR THE PHOTOMETRIC DETERMINATION OF HEADLAMP AIM BY ISOLUX CONTOUR MATCHING

HS-015 698

VEHICLE BRAKING SYSTEMS TEST PROCEDURE--HYDRAULIC BRAKES. FINAL REPORT

HS-801 308

**PROCEDURES**

APPLICATION OF GRID SELECTION PROCEDURES FOR IMPROVED FINITE ELEMENT STRESS ANALYSIS

HS-015 726

PEDESTRIAN CIRCULATION PLANNING: PRINCIPLES, PROCEDURES, PROTOTYPES

HS-015 826

PROCEDURES AND TECHNIQUES FOR PHOTOMETRIC MEASUREMENT OF GONIOMETER-MOUNTED SAE AND ECE HEADLAMPS

HS-015 800

SURVEY OF SOLUTION PROCEDURES FOR NON-LINEAR STATIC AND DYNAMIC ANALYSES

HS-015 707

**PROCEEDINGS**

INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, TROY, MICHIGAN, JULY 10-12, 1974

HS-015 670

INTERNATIONAL CONFERENCE ON VEHICLE STRUCTURAL MECHANICS: FINITE ELEMENT AP-

PLICATION TO VEHICLE DESIGN, PROCEEDINGS, DETROIT, MICHIGAN, MARCH 26-28, 1974

HS-015 706

**PRODUCTION**

PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT (21ST), 1 MARCH TO 31 MARCH 1974

HS-801 364

PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT NO. 22, APRIL 1974

HS-801 378

**PROJECT**

DWI LAW ENFORCEMENT TRAINING PROJECT. EVALUATION AIDS PACKET AND MEDIA LOG

HS-801 345

**PROPERTIES**

A MODAL SYNTHESIS TECHNIQUE FOR DETERMINING DYNAMIC PROPERTIES FOR A STRUCTURE FOR MASS AND STIFFNESS CHANGES

HS-015 719

THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 1. SUMMARY REPORT. FINAL REPORT

HS-801 323

THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 2. TECHNICAL REPORT. FINAL REPORT

HS-801 324

**PROTECTION**

HUMAN CHEST IMPACT PROTECTION CRITERIA

HS-015 696

IN-DEPTH ACCIDENT DATA AND OCCUPANT PROTECTION--A STATISTICAL POINT OF VIEW

HS-015 675

INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, TROY, MICHIGAN, JULY 10-12, 1974

HS-015 670

THE EFFORTS OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION IN THE DEVELOPMENT OF ADVANCED PASSIVE PROTECTION SYSTEMS AND CHILD RESTRAINT SYSTEMS

HS-015 686

**PROTOTYPES**

PEDESTRIAN CIRCULATION PLANNING: PRINCIPLES, PROCEDURES, PROTOTYPES

HS-015 826

**PROVINCE**

DRINKING-DRIVING IN THE PROVINCE OF ONTARIO

HS-015 824

**PUERTO**

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. COMMONWEALTH OF PUERTO RICO. 1971 ACCIDENT YEAR

HS-015 771



May 31, 1975

#### QUALITY

THE ENVIRONMENTAL QUALITY OF CITY  
STREETS: THE RESIDENTS' VIEWPOINT

HS-015 829

UNIFORM TIRE QUALITY GRADING TREADWEAR.  
FINAL REPORT

HS-801 315

#### QUESTIONS

ACCIDENT STUDY RAISES QUESTIONS ON 55 MPH  
NATIONAL SPEED LIMIT

HS-015 764

#### RADAR

BARBI, A NEW RADAR CONCEPT FOR PRECOLLI-  
SION SENSING

HS-015 680

#### RADIO

PERFORMANCE OF VOLUNTEER MONITORS USING  
CITIZENS BAND RADIO FOR A HIGHWAY COMMU-  
NICATIONS SERVICE

HS-015 786

#### RAIL

DEVELOPMENT OF APPROACH RAIL-BRIDGE RAIL  
TRANSITION USING ALUMINUM BALANCED  
SYSTEM

HS-015 797

#### RAISES

ACCIDENT STUDY RAISES QUESTIONS ON 55 MPH  
NATIONAL SPEED LIMIT

HS-015 764

#### RATES

THE EFFECT OF SPEED ON TRUCK FUEL CON-  
SUMPTION RATES

HS-015 756

#### REACH

HOW DRIVERS PREVENTED FROM DRIVING WOULD  
REACH WORK: IMPLICATIONS FOR PENALTIES

HS-015 816

#### REACTION

ANALYSIS OF DRIVER REACTION TO WARNING  
DEVICES AT A HIGH-ACCIDENT RURAL GRADE  
CROSSING. FINAL REPORT

HS-015 750

#### REALLY

THE IMPACT OF DRIVER IMPROVEMENT: DO WE  
REALLY WANT TO KNOW?

HS-015 703

#### RECOMMENDATIONS

DISCUSSION (THE HSRI DUMMY COMPARED WITH  
GENERAL MOTORS BIOFIDELITY RECOMMENDA-  
TIONS AND THE HYBRID 2 DUMMY)

HS-015 695

THE HIGHWAY SAFETY RESEARCH INSTITUTE  
DUMMY COMPARED WITH GENERAL MOTORS  
BIOFIDELITY RECOMMENDATIONS AND THE  
HYBRID 2 DUMMY

HS-015 694

#### RECOMMENDED

ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SUR-  
VEYS OF DRINKING-DRIVING BEHAVIOR: A  
REVIEW OF THE LITERATURE AND A RECOM-  
MENDED METHODOLOGY

HS-015 823

#### RECORDER

AN INEXPENSIVE AUTOMOBILE CRASH RECORDER

HS-015 673

AUTOMOTIVE RECORDER RESEARCH--A SUMMARY  
OF ACCIDENT DATA AND TEST RESULTS

HS-015 672

#### RECREATIONAL

SPEED/FLOW RELATIONS ON RECREATIONAL  
ROADS

HS-015 783

#### REDUCING

DETECTION OF FREEWAY CAPACITY-REDUCING  
INCIDENTS BY TRAFFIC-STREAM MEASUREMENTS

HS-015 785

#### REFORMS

INTERRUPTED TIME-SERIES METHODS FOR THE  
EVALUATION OF TRAFFIC LAW REFORMS

HS-015 705

#### RELATIONS

SPEED/FLOW RELATIONS ON RECREATIONAL  
ROADS

HS-015 783

#### RELATIONSHIP

EXAMINATION OF ALCOHOL INTOXICATION IN  
CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A  
MATHEMATICAL ANALYSIS OF THE RELATIONSHIP  
BETWEEN THE RESULTS OF CLINICAL EXAMINA-  
TION AND BLOOD ALCOHOL

HS-015 784

#### RELATIONSHIPS

AUTOMOBILE INSURANCE LOSSES COLLISION  
COVERAGES. RELATIONSHIPS BETWEEN LOSSES  
AND VEHICLE DENSITY, 1972 AND 1973 MODELS

HS-015 735

#### RELIABILITY

STUDY OF DETECTOR RELIABILITY FOR A MO-  
TORIST INFORMATION SYSTEM ON THE GULF  
FREEWAY

HS-015 787

#### REMEDIES

SOURCES AND REMEDIES FOR RESTRAINT SYSTEM  
DISCOMFORT AND INCONVENIENCES. FINAL  
BRIEFING

HS-801 374

#### REMOTE

NASTRAN PLOTTING AT A REMOTE TERMINAL

HS-015 733

#### RESEARCH

APPLICATIONS OF COMPUTER-GENERATED  
IMAGERY TO DRIVER TRAINING; HIGHWAY  
RESEARCH, AND DESIGN

HS-015 737

- AUTOMOTIVE RECORDER RESEARCH--A SUMMARY OF ACCIDENT DATA AND TEST RESULTS**  
HS-015 672
- ROAD SAFETY AND THE CONSUMER. A MAJOR NEW RESEARCH INITIATIVE**  
HS-015 818
- SIMULATION: ITS ROLE IN DRIVER RESEARCH AND HIGHWAY DESIGN. VOL. 8**  
HS-015 736
- THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY**  
HS-015 694
- THE USE OF HUMAN SUBJECTS IN HUMAN FACTORS RESEARCH**  
HS-015 704
- TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS. VOL. 1--RESEARCH FINDINGS. FINAL REPORT**  
HS-801 334
- RESIDENTS**  
**THE ENVIRONMENTAL QUALITY OF CITY STREETS: THE RESIDENTS' VIEWPOINT**  
HS-015 829
- RESPONSE**  
**FRONT END STRUCTURES CRASH RESPONSE CHARACTERIZATION**  
HS-015 677
- RESTRAINT**  
**IMPROVED RESTRAINT FOR U. S. ARMY AIRCREWMEN**  
HS-015 690
- PERFORMANCE MATRICES OF FOUR RESTRAINT SYSTEMS**  
HS-015 689
- SOURCES AND REMEDIES FOR RESTRAINT SYSTEM DISCOMFORT AND INCONVENIENCES. FINAL BRIEFING**  
HS-801 374
- THE DEVELOPMENT OF AN AIR BAG ON COLLAPSIBLE DASHBOARD RESTRAINT SYSTEM FOR RIGHT FRONT SEAT OCCUPANTS**  
HS-015 682
- THE EFFORTS OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION IN THE DEVELOPMENT OF ADVANCED PASSIVE PROTECTION SYSTEMS AND CHILD RESTRAINT SYSTEMS**  
HS-015 686
- RESULTS**  
**AUTOMOTIVE RECORDER RESEARCH--A SUMMARY OF ACCIDENT DATA AND TEST RESULTS**  
HS-015 672
- DRUG EFFECTS ON VISION: STRATEGIES FOR STUDY AND SELECTED RESULTS**  
HS-015 699
- EXAMINATION OF ALCOHOL INTOXICATION IN CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A MATHEMATICAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE RESULTS OF CLINICAL EXAMINATION AND BLOOD ALCOHOL**  
HS-015 784
- FIRST RESULTS OF EXACT ACCIDENT DATA ACQUISITION ON SCENE**  
HS-015 674
- RETRACTOR**  
**BELT RETRACTOR TESTING WITH STANDARD VEHICLE SEAT. APPENDIX D. MODIFICATION 1.**  
HS-801 386
- REVIEW**  
**ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SURVEYS OF DRINKING-DRIVING BEHAVIOR: A REVIEW OF THE LITERATURE AND A RECOMMENDED METHODOLOGY**  
HS-015 823
- REVIEWING**  
**REVIEWING THE BASICS**  
HS-015 766
- RIGHT**  
**THE DEVELOPMENT OF AN AIR BAG ON COLLAPSIBLE DASHBOARD RESTRAINT SYSTEM FOR RIGHT FRONT SEAT OCCUPANTS**  
HS-015 682
- RIGID**  
**COMPRESSION OF AN INFLATED TUBE BETWEEN RIGID SURFACES AS AN ELEMENTARY TIRE MECHANICS MODEL**  
HS-015 810
- ROAD**  
**A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY PREPARED ON RULES OF THE ROAD UNIFORMITY IN THE TRAFFIC LAWS OF THE SEVERAL STATES**  
HS-820 262
- ROAD SAFETY AND THE CONSUMER. A MAJOR NEW RESEARCH INITIATIVE**  
HS-015 818
- SHOCK ABSORBERS FOR YOUR CAR. PT. 2: DYNAMOMETER, TRACK AND ROAD TESTS OF 10 SHOCKS ON A CORVETTE**  
HS-015 749
- ROADS**  
**SPEED/FLOW RELATIONS ON RECREATIONAL ROADS**  
HS-015 783
- ROADSIDE**  
**ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SURVEYS OF DRINKING-DRIVING BEHAVIOR: A REVIEW OF THE LITERATURE AND A RECOMMENDED METHODOLOGY**  
HS-015 823
- ROADWAYS**  
**DESIGN OF DENSITY-MEASURING SYSTEMS FOR ROADWAYS**  
HS-015 788
- RTOR**  
**RTOR: WARRANTS AND BENEFITS. FINAL REPORT**  
HS-015 752

May 31, 1975

#### **RUBBER**

THE COMPUTATION OF TEARING ENERGY OF NICKED RUBBER STRIPS IN EXTENSION

HS-015 715

#### **RULES**

A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY PREPARED ON RULES OF THE ROAD UNIFORMITY IN THE TRAFFIC LAWS OF THE SEVERAL STATES

HS-820 262

#### **RURAL**

ANALYSIS OF DRIVER REACTION TO WARNING DEVICES AT A HIGH-ACCIDENT RURAL GRADE CROSSING. FINAL REPORT

HS-015 750

#### **SAE**

PROCEDURES AND TECHNIQUES FOR PHOTOMETRIC MEASUREMENT OF GONIOMETER-MOUNTED SAE AND ECE HEADLAMPS

HS-015 800

#### **SAFELY**

DRIVE YOUR CAR SAFELY

HS-015 814

#### **SAFER**

USE OF MATHEMATICAL SIMULATIONS TO DEVELOP SAFER HIGHWAY DESIGN CRITERIA

HS-015 739

#### **SCALE**

AN INTRODUCTION TO SCALE MODEL TESTING TO DETERMINE AIR CUSHION CRASH SENSOR LOCATION

HS-015 691

DEVELOPMENT OF ENERGY ABSORBING AUTOMOTIVE STRUCTURES USING SCALE MODEL TEST TECHNIQUES

HS-015 676

FULL-SCALE EMBANKMENT TESTS AND COMPARISONS WITH A COMPUTER SIMULATION

HS-015 798

SCALE MODELING OF VEHICLE CRASHES--TECHNIQUES, APPLICABILITY, AND ACCURACY; COST EFFECTIVENESS

HS-015 692

#### **SCENE**

FIRST RESULTS OF EXACT ACCIDENT DATA ACQUISITION ON SCENE

HS-015 674

#### **SCHOOL**

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS. PT. 7: TRAFFIC CONTROLS FOR SCHOOL AREAS

HS-015 822

#### **SEAT**

BELT RETRACTOR TESTING WITH STANDARD VEHICLE SEAT. APPENDIX D. MODIFICATION 1.

HS-801 386

DATA FROM FABRICATION OF A STANDARD BENCH VEHICLE SEAT. APPENDIX C

HS-801 385

FABRICATION OF A STANDARD BENCH VEHICLE SEAT. FINAL REPORT

HS-801 384

THE DEVELOPMENT OF AN AIR BAG ON COLLAPSIBLE DASHBOARD RESTRAINT SYSTEM FOR RIGHT FRONT SEAT OCCUPANTS

HS-015 682

#### **SECTION**

A TECHNIQUE FOR CONNECTING BEAM ELEMENTS TO A PLATE MODEL OF A COMPLICATED BOX SECTION

HS-015 729

#### **SELECTION**

APPLICATION OF GRID SELECTION PROCEDURES FOR IMPROVED FINITE ELEMENT STRESS ANALYSIS

HS-015 726

#### **SENSING**

BARBI, A NEW RADAR CONCEPT FOR PRECOLLISION SENSING

HS-015 680

#### **SENSOR**

AN INTRODUCTION TO SCALE MODEL TESTING TO DETERMINE AIR CUSHION CRASH SENSOR LOCATION

HS-015 691

FLUID CRASH SENSOR

HS-015 681

#### **SERIES**

INTERRUPTED TIME-SERIES METHODS FOR THE EVALUATION OF TRAFFIC LAW REFORMS

HS-015 705

#### **SERVICE**

PERFORMANCE OF VOLUNTEER MONITORS USING CITIZENS BAND RADIO FOR A HIGHWAY COMMUNICATIONS SERVICE

HS-015 786

#### **SET**

ELECTRIC CARS--SET FOR ANOTHER COMEBACK

HS-015 748

#### **SEVERITY**

ENERGY BASIS FOR COLLISION SEVERITY

HS-015 671

#### **SHEET**

STIFFNESS ANALYSIS OF SHEET METAL SHELLS UNDER CONCENTRATED LOADS

HS-015 725

#### **SHELLS**

STIFFNESS ANALYSIS OF SHEET METAL SHELLS UNDER CONCENTRATED LOADS

HS-015 725

#### **SHOCK**

SHOCK ABSORBERS FOR YOUR CAR. PT. 2: DYNAMOMETER, TRACK AND ROAD TESTS OF 10 SHOCKS ON A CORVETTE

HS-015 749

**SHOCKS**

SHOCK ABSORBERS FOR YOUR CAR. PT. 2:  
DYNAMOMETER, TRACK AND ROAD TESTS OF 10  
SHOCKS ON A CORVETTE

HS-015 749

**SIDE**

COMPOSITE MATERIALS IN AUTOMOBILE SIDE  
STRUCTURES--FEASIBILITY EVALUATION.  
MONTHLY LETTER REPORT NO. 13, JUNE 1974

HS-801 365

COMPOSITE MATERIALS IN AUTOMOBILE SIDE  
STRUCTURES--FEASIBILITY EVALUATION.  
MONTHLY LETTER REPORT NO. 14, JULY 1974

HS-801 373

**SIDEWALL**

CONTOURING THE TIRE SIDEWALL WITH MOIRE

HS-015 811

**SIGN**

ALGORITHM FOR A REAL-TIME ADVISORY SIGN  
CONTROL SYSTEM FOR URBAN HIGHWAYS

HS-015 790

**SIGNALISED**

PEDESTRIAN BEHAVIOR AT SIGNALISED INTER-  
SECTIONS

HS-015 765

**SIGNS**

CRASH TESTS AND EVALUATION OF SINGLE POST  
HIGHWAY SIGNS. INTERIM REPORT

HS-015 782

**SIMULATION**

FULL-SCALE EMBANKMENT TESTS AND COM-  
PARISONS WITH A COMPUTER SIMULATION

HS-015 798

SIMULATION AND SIMULATORS: A SELECTED  
BIBLIOGRAPHY

HS-015 740

SIMULATION: ITS ROLE IN DRIVER RESEARCH AND  
HIGHWAY DESIGN. VOL. 8

HS-015 736

TEST SLED SIMULATION OF CRASH INDUCED YAW  
AND PITCH

HS-015 693

**SIMULATIONS**

USE OF MATHEMATICAL SIMULATIONS TO  
DEVELOP SAFER HIGHWAY DESIGN CRITERIA

HS-015 739

**SIMULATORS**

SIMULATION AND SIMULATORS: A SELECTED  
BIBLIOGRAPHY

HS-015 740

SIMULATORS: BOON OR BOONDOGGLE?

HS-015 738

**SINGLE**

CRASH TESTS AND EVALUATION OF SINGLE POST  
HIGHWAY SIGNS. INTERIM REPORT

HS-015 782

**SIR**

A PROPOSED NEW NATIONAL SYSTEM FOR COL-  
LECTING MULTIPURPOSE ACCIDENT DATA: SIR

HS-015 757

**SIZE**

DEVELOPMENT AND EVALUATION OF A STRUC-  
TURAL CRASHWORTHINESS SYSTEM FOR A STAND-  
ARD SIZE AUTOMOBILE. EXECUTIVE SUMMARY.  
FINAL REPORT

HS-801 318

PRODUCTION FEASIBILITY--CRASHWORTHINESS  
STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS  
REPORT (21ST), 1 MARCH TO 31 MARCH 1974

HS-801 364

PRODUCTION FEASIBILITY--CRASHWORTHINESS  
STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS  
REPORT NO. 22, APRIL 1974

HS-801 378

**SIZED**

STUDY ON AIR BAG SYSTEMS FOR NISSAN SMALL-  
SIZED CARS

HS-015 683

**SLED**

TEST SLED SIMULATION OF CRASH INDUCED YAW  
AND PITCH

HS-015 693

**SMALL**

ANGLE AND SMALL-CAR IMPACT TESTS OF AN AR-  
TICULATED GORE BARRIER EMPLOYING  
LIGHTWEIGHT CONCRETE ENERGY-ABSORBING  
CARTRIDGES

HS-015 792

STUDY ON AIR BAG SYSTEMS FOR NISSAN SMALL-  
SIZED CARS

HS-015 683

THEORETICAL AND EXPERIMENTAL INVESTIGA-  
TIONS ON THE CRASHWORTHINESS OF SMALL  
CARS

HS-015 679

**SOLUTION**

SURVEY OF SOLUTION PROCEDURES FOR NON-  
LINEAR STATIC AND DYNAMIC ANALYSES

HS-015 707

**SOLVING**

THE USE OF CONDENSATION TECHNIQUES FOR  
SOLVING DYNAMICS PROBLEMS

HS-015 720

**SOURCES**

SOURCES AND REMEDIES FOR RESTRAINT SYSTEM  
DISCOMFORT AND INCONVENIENCES. FINAL  
BRIEFING

HS-801 374

**SPECTRAL**

POWER SPECTRAL DENSITY ANALYSIS OF VEHI-  
CLE VIBRATION USING THE NASTRAN COMPUTER  
PROGRAM

HS-015 718

ACCIDENT STUDY RAISES QUESTIONS ON 55 MPH  
NATIONAL SPEED LIMIT

HS-015 764

THE EFFECT OF SPEED ON TRUCK FUEL CON-  
SUMPTION RATES

HS-015 756

#### **SPEED/FLOW**

SPEED/FLOW RELATIONS ON RECREATIONAL  
ROADS

HS-015 783

#### **STANDARD**

BELT RETRACTOR TESTING WITH STANDARD  
VEHICLE SEAT. APPENDIX D. MODIFICATION 1.

HS-801 386

DATA FROM FABRICATION OF A STANDARD  
BENCH VEHICLE SEAT. APPENDIX C

HS-801 385

DEVELOPMENT AND EVALUATION OF A STRUC-  
TURAL CRASHWORTHINESS SYSTEM FOR A STAND-  
ARD SIZE AUTOMOBILE. EXECUTIVE SUMMARY.  
FINAL REPORT

HS-801 318

FABRICATION OF A STANDARD BENCH VEHICLE  
SEAT. FINAL REPORT

HS-801 384

#### **STARTER**

FACTORS ASSOCIATED WITH SAFETY BELT USE IN  
1974 STARTER-INTERLOCK EQUIPPED CARS

HS-015 815

#### **STATES**

A CONTEMPORARY OVERVIEW OF TRAFFIC LAW  
UNIFORMITY IN THE UNITED STATES. A STUDY  
PREPARED ON RULES OF THE ROAD UNIFORMITY  
IN THE TRAFFIC LAWS OF THE SEVERAL STATES

HS-820 262

COMMUTER DEMAND FOR BICYCLE TRANSPORTA-  
TION IN THE UNITED STATES

HS-015 700

#### **STATIC**

STATIC ANALYSIS VIA SUBSTRUCTURING OF AN  
EXPERIMENTAL VEHICLE FRONT-END BODY  
STRUCTURE

HS-015 713

SURVEY OF SOLUTION PROCEDURES FOR NON-  
LINEAR STATIC AND DYNAMIC ANALYSES

HS-015 707

#### **STATISTICAL**

IN-DEPTH ACCIDENT DATA AND OCCUPANT PRO-  
TECTION--A STATISTICAL POINT OF VIEW

HS-015 675

#### **STIFFNESS**

A MODAL SYNTHESIS TECHNIQUE FOR DETERMIN-  
ING DYNAMIC PROPERTIES FOR A STRUCTURE FOR  
MASS AND STIFFNESS CHANGES

HS-015 719

STIFFNESS ANALYSIS OF SHEET METAL SHELLS  
UNDER CONCENTRATED LOADS

HS-015 725

#### **STRAIN**

THE ROLE OF FINITE DEFORMATION ANALYSIS IN  
PLANE STRESS AND STRAIN FRACTURES

HS-015 722

#### **STRATEGIES**

DRUG EFFECTS ON VISION: STRATEGIES FOR  
STUDY AND SELECTED RESULTS

HS-015 699

#### **STREAM**

DETECTION OF FREEWAY CAPACITY-REDUCING  
INCIDENTS BY TRAFFIC-STREAM MEASUREMENTS

HS-015 785

#### **STREETS**

MANUAL ON UNIFORM TRAFFIC CONTROL  
DEVICES FOR STREETS AND HIGHWAYS. PT. 7:  
TRAFFIC CONTROLS FOR SCHOOL AREAS

HS-015 822

THE ENVIRONMENTAL QUALITY OF CITY  
STREETS: THE RESIDENTS' VIEWPOINT

HS-015 829

#### **STRESS**

APPLICATION OF GRID SELECTION PROCEDURES  
FOR IMPROVED FINITE ELEMENT STRESS ANALY-  
SIS

HS-015 726

ELASTO-PLASTIC ANALYSIS OF STRESS IN A GAS-  
TURBINE WHEEL

HS-015 723

THE ROLE OF FINITE DEFORMATION ANALYSIS IN  
PLANE STRESS AND STRAIN FRACTURES

HS-015 722

#### **STRESSES**

AN AXISYMMETRIC FINITE ELEMENT ANALYSIS  
OF THE MECHANICAL AND THERMAL STRESSES in  
brake drums

HS-015 711

#### **STRIPS**

THE COMPUTATION OF TEARING ENERGY OF  
NICKED RUBBER STRIPS IN EXTENSION

HS-015 715

#### **STRUCTURAL**

AN INTERACTIVE HYBRID TECHNIQUE FOR  
CRASHWORTHY DESIGN OF COMPLEX VEHICULAR  
STRUCTURAL SYSTEMS

HS-015 717

APPLICATION OF FINITE ELEMENT METHODS TO  
COMPLETE AUTOMOBILE STRUCTURAL DESIGN  
EVALUATION

HS-015 712

DEVELOPMENT AND EVALUATION OF A STRUC-  
TURAL CRASHWORTHINESS SYSTEM FOR A STAND-  
ARD SIZE AUTOMOBILE. EXECUTIVE SUMMARY.  
FINAL REPORT

HS-801 318

FINITE ELEMENT STRUCTURAL ANALYSIS AS AP-  
PLIED TO AN AUTOMOTIVE DOOR STRUCTURE

HS-015 710

INTERNATIONAL CONFERENCE ON VEHICLE  
STRUCTURAL MECHANICS: FINITE ELEMENT AP-

PLICATION TO VEHICLE DESIGN, PROCEEDINGS,  
DETROIT, MICHIGAN, MARCH 26-28, 1974

HS-015 706

**STRUCTURE**

A MODAL SYNTHESIS TECHNIQUE FOR DETERMINING DYNAMIC PROPERTIES FOR A STRUCTURE FOR MASS AND STIFFNESS CHANGES

HS-015 719

FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, SEPTEMBER 1974

HS-801 362

FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, JUNE-JULY 1974

HS-801 363

FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, DECEMBER 1974

HS-801 370

FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, NOVEMBER 1974

HS-801 371

FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, AUGUST 1974

HS-801 372

FINITE ELEMENT STRUCTURAL ANALYSIS AS APPLIED TO AN AUTOMOTIVE DOOR STRUCTURE

HS-015 710

PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT (21ST), 1 MARCH TO 31 MARCH 1974

HS-801 364

PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT NO. 22, APRIL 1974

HS-801 378

STATIC ANALYSIS VIA SUBSTRUCTURING OF AN EXPERIMENTAL VEHICLE FRONT-END BODY STRUCTURE

HS-015 713

**STRUCTURES**

COMPOSITE MATERIALS IN AUTOMOBILE SIDE STRUCTURES--FEASIBILITY EVALUATION. MONTHLY LETTER REPORT NO. 13, JUNE 1974

HS-801 365

COMPOSITE MATERIALS IN AUTOMOBILE SIDE STRUCTURES--FEASIBILITY EVALUATION. MONTHLY LETTER REPORT NO. 14, JULY 1974

HS-801 373

DEVELOPMENT OF ENERGY ABSORBING AUTOMOTIVE STRUCTURES USING SCALE MODEL TEST TECHNIQUES

HS-015 676

FINITE ELEMENT ANALYSIS OF AUTOMOBILE STRUCTURES

HS-015 709

FRONT END STRUCTURES CRASH RESPONSE CHARACTERIZATION

HS-015 677

**SUBCOMPACT**

CRASH ENERGY MANAGEMENT IN SUBCOMPACT AUTOMOBILES

HS-015 678

INFLATABLE BELT DEVELOPMENT FOR SUBCOMPACT CAR PASSENGERS. PROGRESS REPORT, SEPTEMBER 1974

HS-801 369

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, SEPTEMBER 1974

HS-801 361

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, AUGUST 1974

HS-801 367

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, JULY 1974

HS-801 368

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, NOVEMBER 1974

HS-801 377

**SUBJECTS**

THE USE OF HUMAN SUBJECTS IN HUMAN FACTORS RESEARCH

HS-015 704

**SUBSTRUCTURING**

STATIC ANALYSIS VIA SUBSTRUCTURING OF AN EXPERIMENTAL VEHICLE FRONT-END BODY STRUCTURE

HS-015 713

**SURFACES**

COMPRESSION OF AN INFLATED TUBE BETWEEN RIGID SURFACES AS AN ELEMENTARY TIRE MECHANICS MODEL

HS-015 810

**SURVEY**

SURVEY OF SOLUTION PROCEDURES FOR NON-LINEAR STATIC AND DYNAMIC ANALYSES

HS-015 707

**SURVEYS**

ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SURVEYS OF DRINKING-DRIVING BEHAVIOR: A REVIEW OF THE LITERATURE AND A RECOMMENDED METHODOLOGY

HS-015 823

**SUSPECTED**

EXAMINATION OF ALCOHOL INTOXICATION IN CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A MATHEMATICAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE RESULTS OF CLINICAL EXAMINATION AND BLOOD ALCOHOL

HS-015 784

**SUSPENSION**

IMPROVEMENT IN DYNAMIC CHARACTERISTICS OF AUTOMOBILE SUSPENSION SYSTEMS. PT. 2. THREE-MASS SYSTEMS

HS-015 804

**SYNTHESIS**

A MODAL SYNTHESIS TECHNIQUE FOR DETERMINING DYNAMIC PROPERTIES FOR A STRUCTURE FOR MASS AND STIFFNESS CHANGES

HS-015 719

May 31, 1975

## TAPE

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF FLORIDA, 1971 ACCIDENT YEAR

HS-015 741

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF UTAH, 1971 ACCIDENT YEAR

HS-015 742

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF VERMONT, 1971 ACCIDENT YEAR

HS-015 743

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF WASHINGTON, 1972 ACCIDENT YEAR

HS-015 744

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF WYOMING, 1971 ACCIDENT YEAR

HS-015 745

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. COMMONWEALTH OF PUERTO RICO, 1971 ACCIDENT YEAR

HS-015 771

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF MINNESOTA, 1972 ACCIDENT YEAR

HS-015 772

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF MISSOURI, 1972 ACCIDENT YEAR

HS-015 773

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF MONTANA, 1972 ACCIDENT YEAR

HS-015 774

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF WISCONSIN, 1973 ACCIDENT YEAR

HS-015 775

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF OKLAHOMA, 1971 ACCIDENT YEAR

HS-015 806

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF MISSOURI, 1971 ACCIDENT YEAR

HS-015 807

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF NEW MEXICO, 1972 ACCIDENT YEAR

HS-015 808

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF NEVADA, 1972 ACCIDENT YEAR

HS-015 809

## TEARING

THE COMPUTATION OF TEARING ENERGY OF NICKED RUBBER STRIPS IN EXTENSION

HS-015 715

## TECHNIQUES

DEVELOPMENT OF ENERGY ABSORBING AUTOMOTIVE STRUCTURES USING SCALE MODEL TEST TECHNIQUES

HS-015 676

OPTIMIZATION TECHNIQUES APPLIED TO IMPROVING FREEWAY OPERATIONS

HS-015 791

PROCEDURES AND TECHNIQUES FOR PHOTOMETRIC MEASUREMENT OF GONIOMETER-MOUNTED SAE AND ECE HEADLAMPS

HS-015 800

SCALE MODELING OF VEHICLE CRASHES--TECHNIQUES, APPLICABILITY, AND ACCURACY; COST EFFECTIVENESS

HS-015 692

THE USE OF CONDENSATION TECHNIQUES FOR SOLVING DYNAMICS PROBLEMS

HS-015 720

## TERMINAL

DEVELOPMENT OF A NEW MEDIAN BARRIER TERMINAL

HS-015 795

NASTRAN PLOTTING AT A REMOTE TERMINAL

HS-015 733

## TEST

AUTOMOTIVE RECORDER RESEARCH--A SUMMARY OF ACCIDENT DATA AND TEST RESULTS

HS-015 672

BRAKING EFFICIENCY TEST TECHNIQUE. FINAL REPORT

HS-801 352

BRAKING EFFICIENCY TEST TECHNIQUE. SUMMARY REPORT

HS-801 353

CRASH TEST EVALUATION OF THREE BEAM TRAFFIC BARRIERS

HS-015 796

DEVELOPMENT OF ENERGY ABSORBING AUTOMOTIVE STRUCTURES USING SCALE MODEL TEST TECHNIQUES

HS-015 676

TEST SLED SIMULATION OF CRASH INDUCED YAW AND PITCH

HS-015 693

VEHICLE BRAKING SYSTEMS TEST PROCEDURE--HYDRAULIC BRAKES. FINAL REPORT

HS-801 308

## TESTING

AN INTRODUCTION TO SCALE MODEL TESTING TO DETERMINE AIR CUSHION CRASH SENSOR LOCATION

HS-015 691

BELT RETRACTOR TESTING WITH STANDARD VEHICLE SEAT. APPENDIX D. MODIFICATION 1.

HS-801 386

TESTING CRASH DUMMIES

HS-015 753

**TESTS**

ANGLE AND SMALL-CAR IMPACT TESTS OF AN ARTICULATED GORE BARRIER EMPLOYING LIGHTWEIGHT CONCRETE ENERGY-ABSORBING CARTRIDGES

HS-015 792

CRASH TESTS AND EVALUATION OF SINGLE POST HIGHWAY SIGNS. INTERIM REPORT

HS-015 782

FULL-SCALE EMBANKMENT TESTS AND COMPARISONS WITH A COMPUTER SIMULATION

HS-015 798

HUMAN VOLUNTEER AND ANTHROPOMORPHIC DUMMY TESTS OF GENERAL MOTORS DRIVER AIR CUSHION SYSTEM

HS-015 684

SHOCK ABSORBERS FOR YOUR CAR. PT. 2: DYNAMOMETER, TRACK AND ROAD TESTS OF 10 SHOCKS ON A CORVETTE

HS-015 749

TESTS FOR HAZARDOUS FAILURE OF ENERGY ABSORBING AUTOMOTIVE BUMPER CYLINDERS. REPORT

HS-015 802

**THEORETICAL**

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE CRASHWORTHINESS OF SMALL CARS

HS-015 679

**THERMAL**

AN AXISYMMETRIC FINITE ELEMENT ANALYSIS OF THE MECHANICAL AND THERMAL STRESSES in brake drums

HS-015 711

**THRIE**

CRASH TEST EVALUATION OF THRIE BEAM TRAFFIC BARRIERS

HS-015 796

**TIMBER**

A BREAKAWAY CONCEPT FOR TIMBER UTILITY POLES

HS-015 799

**TIME**

ALGORITHM FOR A REAL-TIME ADVISORY SIGN CONTROL SYSTEM FOR URBAN HIGHWAYS

HS-015 790

INTERRUPTED TIME-SERIES METHODS FOR THE EVALUATION OF TRAFFIC LAW REFORMS

HS-015 705

**TIRE**

ANALYSIS OF THE WEAR OF MULTISECTIONED TIRE TREADS

HS-015 813

COMPRESSION OF AN INFLATED TUBE BETWEEN RIGID SURFACES AS AN ELEMENTARY TIRE MECHANICS MODEL

HS-015 810

CONTOURING THE TIRE SIDEWALL WITH MOIRE

HS-015 811

LARGE-TRUCK ACCIDENTS INVOLVING TIRE FAILURE. FINAL REPORT

HS-015 803

THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 1. SUMMARY REPORT. FINAL REPORT

HS-801 323

THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 2. TECHNICAL REPORT. FINAL REPORT

HS-801 324

TIRE DEFORMATION DURING DYNAMIC HYDROPLANING

HS-015 755

UNIFORM TIRE QUALITY GRADING TREADWEAR. FINAL REPORT

HS-801 315

**TOOL**

FINITE ELEMENT ANALYSIS, AN AUTOMOBILE ENGINEER'S TOOL

HS-015 728

**TRACK**

SHOCK ABSORBERS FOR YOUR CAR. PT. 2: DYNAMOMETER, TRACK AND ROAD TESTS OF 10 SHOCKS ON A CORVETTE

HS-015 749

**TRADING**

THE EFFECT ON TRAFFIC ACCIDENTS OF EXTENDED TRADING HOURS AT HOTELS

HS-015 760

**TRAFFIC**

A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY PREPARED ON RULES OF THE ROAD UNIFORMITY IN THE TRAFFIC LAWS OF THE SEVERAL STATES

HS-820 262

AN ANALYSIS OF TRAFFIC ACCIDENTS IN NEW ZEALAND

HS-015 759

CRASH TEST EVALUATION OF THRIE BEAM TRAFFIC BARRIERS

HS-015 796

DETECTION OF FREEWAY CAPACITY-REDUCING INCIDENTS BY TRAFFIC-STREAM MEASUREMENTS

HS-015 785

HIGHWAY SAFETY PROGRAM MANUAL. VOL. 7. TRAFFIC COURTS

HS-801 349

INTERRUPTED TIME-SERIES METHODS FOR THE EVALUATION OF TRAFFIC LAW REFORMS

HS-015 705

INVESTIGATION OF FLOW-DENSITY DISCONTINUITY AND DUAL-MODE TRAFFIC BEHAVIOR

HS-015 789

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS. PT. 7: TRAFFIC CONTROLS FOR SCHOOL AREAS

HS-015 822

THE EFFECT ON TRAFFIC ACCIDENTS OF EXTENDED TRADING HOURS AT HOTELS

HS-015 760



May 31, 1975

THE EFFORTS OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION IN THE DEVELOPMENT OF ADVANCED PASSIVE PROTECTION SYSTEMS AND CHILD RESTRAINT SYSTEMS

HS-015 686

THE TRAFFIC CONFLICTS TECHNIQUE: AN ACCIDENT PREDICTION METHOD

HS-015 801

TRAFFIC INFORMATION SYSTEM. PHASE 3. FINAL REPORT

HS-015 776

TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS. VOL. 1--RESEARCH FINDINGS. FINAL REPORT

HS-801 334

TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS: INTERIM REPORT I. VOL. 2--APPENDICES.

HS-801 335

#### TRAILER

TRAILER POINTERS AND DRIVING HINTS FOR PASSENGER CAR OWNERS

HS-015 761

#### TRAINING

APPLICATIONS OF COMPUTER-GENERATED IMAGERY TO DRIVER TRAINING; HIGHWAY RESEARCH, AND DESIGN

HS-015 737

DWI LAW ENFORCEMENT TRAINING PROJECT. EVALUATION AIDS PACKET AND MEDIA LOG

HS-801 345

#### TRANSIENT

LARGE DISPLACEMENT, NONLINEAR TRANSIENT ANALYSIS BY FINITE ELEMENTS

HS-015 724

#### TRANSITION

DEVELOPMENT OF APPROACH RAIL-BRIDGE RAIL TRANSITION USING ALUMINUM BALANCED SYSTEM

HS-015 797

#### TRANSPORTATION

COMMUTER DEMAND FOR BICYCLE TRANSPORTATION IN THE UNITED STATES

HS-015 700

#### TRAVEL

DESTINATION CHOICE MODELLING AND THE DISAGGREGATE ANALYSIS OF URBAN TRAVEL BEHAVIOR. FINAL REPORT

HS-015 751

FLEXIBLE WORKING HOURS. A STUDY OF AN EXPERIMENT IN FLEXIBLE WORKING HOURS TO DETERMINE CHANGES IN TRAVEL PATTERNS

HS-015 758

#### TREAD

PATTERNS OF TREAD WEAR AND ESTIMATED TREAD LIFE

HS-015 812

#### TREADS

ANALYSIS OF THE WEAR OF MULTISECTIONED TIRE TREADS

HS-015 813

#### TREADWEAR

UNIFORM TIRE QUALITY GRADING TREADWEAR. FINAL REPORT

HS-801 315

#### TRI

TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS. VOL. 1--RESEARCH FINDINGS. FINAL REPORT

HS-801 334

TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS: INTERIM REPORT I. VOL. 2--APPENDICES.

HS-801 335

#### TROY

INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, TROY, MICHIGAN, JULY 10-12, 1974

HS-015 670

#### TRUCK

DESIGNING TRUCK DISC BRAKES

HS-015 763

LARGE-TRUCK ACCIDENTS INVOLVING TIRE FAILURE. FINAL REPORT

HS-015 803

THE EFFECT OF SPEED ON TRUCK FUEL CONSUMPTION RATES

HS-015 756

#### TUBE

COMPRESSION OF AN INFLATED TUBE BETWEEN RIGID SURFACES AS AN ELEMENTARY TIRE MECHANICS MODEL

HS-015 810

#### TUBULAR

THE FLEXIBILITY OF A TUBULAR WELDED JOINT IN A VEHICLE FRAME

HS-015 730

#### TURBINE

ELASTO-PLASTIC ANALYSIS OF STRESS IN A GAS-TURBINE WHEEL

HS-015 723

#### UCIN

USER'S MANUAL FOR UCIN VEHICLE-OCCUPANT CRASH-STUDY MODEL

HS-015 769

#### UNIFORMITY

A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY PREPARED ON RULES OF THE ROAD UNIFORMITY IN THE TRAFFIC LAWS OF THE SEVERAL STATES

HS-820 262

#### UNITED

A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY PREPARED ON RULES OF THE ROAD UNIFORMITY IN THE TRAFFIC LAWS OF THE SEVERAL STATES

HS-820 262

# COMMUTER DEMAND FOR BICYCLE TRANSPORTATION IN THE UNITED STATES

HS-015 700

## UPDATE

DRIVER INJURY IN AUTOMOBILE ACCIDENTS INVOLVING CERTAIN CAR MODELS: AN UPDATE

HS-015 668

## URBAN

ALGORITHM FOR A REAL-TIME ADVISORY SIGN CONTROL SYSTEM FOR URBAN HIGHWAYS

HS-015 790

DESTINATION CHOICE MODELLING AND THE DISAGGREGATE ANALYSIS OF URBAN TRAVEL BEHAVIOR. FINAL REPORT

HS-015 751

## USER

A USER-ORIENTED PROGRAM FOR CRASH DYNAMICS

HS-015 721

USER'S MANUAL FOR UCIN VEHICLE-OCCUPANT CRASH-STUDY MODEL

HS-015 769

## UTAH

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF UTAH. 1971 ACCIDENT YEAR

HS-015 742

## UTILITY

A BREAKAWAY CONCEPT FOR TIMBER UTILITY POLES

HS-015 799

## VEHICLE

AUTOMOBILE INSURANCE LOSSES COLLISION COVERAGES. RELATIONSHIPS BETWEEN LOSSES AND VEHICLE DENSITY, 1972 AND 1973 MODELS

HS-015 735

BELT RETRACTOR TESTING WITH STANDARD VEHICLE SEAT. APPENDIX D. MODIFICATION 1.

HS-801 386

DATA FROM FABRICATION OF A STANDARD BENCH VEHICLE SEAT. APPENDIX C

HS-801 385

FABRICATION OF A STANDARD BENCH VEHICLE SEAT. FINAL REPORT

HS-801 384

FIRE IN MOTOR VEHICLE ACCIDENTS

HS-015 817

INTERNATIONAL CONFERENCE ON VEHICLE STRUCTURAL MECHANICS: FINITE ELEMENT APPLICATION TO VEHICLE DESIGN, PROCEEDINGS, DETROIT, MICHIGAN, MARCH 26-28, 1974

HS-015 706

NASTRAN FOR DYNAMIC ANALYSIS OF VEHICLE SYSTEMS

HS-015 716

POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. REPORT TO THE CONGRESS

HS-015 768

POWER SPECTRAL DENSITY ANALYSIS OF VEHICLE VIBRATION USING THE NASTRAN COMPUTER PROGRAM

HS-015 718

SCALE MODELING OF VEHICLE CRASHES--TECHNIQUES, APPLICABILITY, AND ACCURACY; COST EFFECTIVENESS

HS-015 692

STATIC ANALYSIS VIA SUBSTRUCTURING OF AN EXPERIMENTAL VEHICLE FRONT-END BODY STRUCTURE

HS-015 713

THE FLEXIBILITY OF A TUBULAR WELDED JOINT IN A VEHICLE FRAME

HS-015 730

THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 1. SUMMARY REPORT. FINAL REPORT

HS-801 323

THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 2. TECHNICAL REPORT. FINAL REPORT

HS-801 324

USER'S MANUAL FOR UCIN VEHICLE-OCCUPANT CRASH-STUDY MODEL

HS-015 769

VEHICLE BRAKING SYSTEMS TEST PROCEDURE--HYDRAULIC BRAKES. FINAL REPORT

HS-801 308

VEHICLE-ARRESTING SYSTEM USING CHAIN-LINK FENCE

HS-015 793

## VEHICULAR

AN INTERACTIVE HYBRID TECHNIQUE FOR CRASHWORTHY DESIGN OF COMPLEX VEHICULAR STRUCTURAL SYSTEMS

HS-015 717

## VELOCITY

A FORCE LIMITING SYSTEM ON A THREE-POINT-BELT SYSTEM DEPENDING ON CRASH VELOCITY

HS-015 688

## VERMONT

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF VERMONT. 1971 ACCIDENT YEAR

HS-015 743

## VIBRATION

POWER SPECTRAL DENSITY ANALYSIS OF VEHICLE VIBRATION USING THE NASTRAN COMPUTER PROGRAM

HS-015 718

## VIBRATIONS

SCHWINGUNGSUNTERSUCHUNGEN AN EINER PKW-KAROSSERIE (INVESTIGATIONS INTO THE VIBRATIONS OF AN AUTOMOBILE BODY)

HS-015 805

## VIEW

IN-DEPTH ACCIDENT DATA AND OCCUPANT PROTECTION--A STATISTICAL POINT OF VIEW

HS-015 675

<b>VIEWPOINT</b> THE ENVIRONMENTAL QUALITY OF CITY STREETS: THE RESIDENTS' VIEWPOINT HS-015 829	IN A VEHICLE FRAME HS-015 730
<b>VISION</b> DRUG EFFECTS ON VISION: STRATEGIES FOR STUDY AND SELECTED RESULTS HS-015 699	<b>WET</b> A NEW WET CLUTCH FAN DRIVE SYSTEM HS-015 821
<b>VOLUNTEER</b> HUMAN VOLUNTEER AND ANTHROPOMORPHIC DUMMY TESTS OF GENERAL MOTORS DRIVER AIR CUSHION SYSTEM HS-015 684  PERFORMANCE OF VOLUNTEER MONITORS USING CITIZENS BAND RADIO FOR A HIGHWAY COMMU- NICATIONS SERVICE HS-015 786	<b>WHEEL</b> ELASTO-PLASTIC ANALYSIS OF STRESS IN A GAS- TURBINE WHEEL HS-015 723
<b>WARNING</b> ANALYSIS OF DRIVER REACTION TO WARNING DEVICES AT A HIGH-ACCIDENT RURAL GRADE CROSSING. FINAL REPORT HS-015 750	<b>WISCONSIN</b> CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF WISCONSIN. 1973 ACCIDENT YEAR HS-015 775
<b>WARRANTS</b> RTOR: WARRANTS AND BENEFITS. FINAL REPORT HS-015 752	<b>WORK</b> ALL ABOUT CATALYTIC CONVERTERS. HOW THEY WORK AND WHAT YOU CAN EXPECT IN PER- FORMANCE HS-015 767  HOW DRIVERS PREVENTED FROM DRIVING WOULD REACH WORK: IMPLICATIONS FOR PENALTIES HS-015 816
<b>WASHINGTON</b> CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF WASHINGTON. 1972 ACCIDENT YEAR HS-015 744	<b>WORKING</b> FLEXIBLE WORKING HOURS. A STUDY OF AN EX- PERIMENT IN FLEXIBLE WORKING HOURS TO DETERMINE CHANGES IN TRAVEL PATTERNS HS-015 758
<b>WEAR</b> ANALYSIS OF THE WEAR OF MULTISECTIONED TIRE TREADS HS-015 813  PATTERNS OF TREAD WEAR AND ESTIMATED READ LIFE HS-015 812	<b>WYOMING</b> CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF WYOMING. 1971 ACCIDENT YEAR HS-015 745
<b>WEBBING</b> DEVELOPMENT OF ENERGY-ABSORBING SAFETY BELT WEBBING HS-015 687	<b>YAW</b> TEST SLED SIMULATION OF CRASH INDUCED YAW AND PITCH HS-015 693
<b>WELDED</b> THE FLEXIBILITY OF A TUBULAR WELDED JOINT	<b>YOUTH</b> IDENTIFICATION OF COUNTERMEASURES FOR THE YOUTH CRASH PROBLEM RELATED TO ALCOHOL. FINAL REPORT HS-801 344
	<b>ZEALAND</b> AN ANALYSIS OF TRAFFIC ACCIDENTS IN NEW ZEALAND HS-015 759

## Author Index

- Abe, F.**  
STUDY ON AIR BAG SYSTEMS FOR NISSAN SMALL-SIZED CARS  
HS-015 683
- Adomeit, D.**  
A FORCE LIMITING SYSTEM ON A THREE-POINT-BELT SYSTEM DEPENDING ON CRASH VELOCITY  
HS-015 688
- Alison, G.**  
DEVELOPMENT OF APPROACH RAIL-BRIDGE RAIL TRANSITION USING ALUMINUM BALANCED SYSTEM  
HS-015 797
- Anderson, R. L.**  
FRONT END STRUCTURES CRASH RESPONSE CHARACTERIZATION  
HS-015 677  
  
VEHICLE BRAKING SYSTEMS TEST PROCEDURE--HYDRAULIC BRAKES. FINAL REPORT  
HS-801 308
- Androsch, W.**  
PEDESTRIAN BEHAVIOR AT SIGNALISED INTERSECTIONS  
HS-015 765
- Ansah, J. A.**  
DESTINATION CHOICE MODELLING AND THE DISAGGREGATE ANALYSIS OF URBAN TRAVEL BEHAVIOR. FINAL REPORT  
HS-015 751
- Appleyard, D.**  
THE ENVIRONMENTAL QUALITY OF CITY STREETS: THE RESIDENTS' VIEWPOINT  
HS-015 829
- Athol, P. J.**  
INVESTIGATION OF FLOW-DENSITY DISCONTINUITY AND DUAL-MODE TRAFFIC BEHAVIOR  
HS-015 789
- Baker, R. G.**  
HUMAN VOLUNTEER AND ANTHROPOMORPHIC DUMMY TESTS OF GENERAL MOTORS DRIVER AIR CUSHION SYSTEM  
HS-015 684
- Baker, S. P.**  
HOW DRIVERS PREVENTED FROM DRIVING WOULD REACH WORK: IMPLICATIONS FOR PENALTIES  
HS-015 816
- Barron, G. E.**  
THE USE OF ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS IN THE CALCULATION OF CUMULATIVE FATIGUE DAMAGE  
HS-015 714
- Behm, W. E.**  
CRASH TEST EVALUATION OF THREE BEAM TRAFFIC BARRIERS  
HS-015 796
- Belytschko, T.**  
LARGE DISPLACEMENT, NONLINEAR TRANSIENT ANALYSIS BY FINITE ELEMENTS  
HS-015 724
- Benjamin, T.**  
ROAD SAFETY AND THE CONSUMER. A MAJOR NEW RESEARCH INITIATIVE  
HS-015 818
- Benson, J. B.**  
FABRICATION OF A STANDARD BENCH VEHICLE SEAT. FINAL REPORT  
HS-801 384
- Birchler, W. D.**  
USING INTERACTIVE GRAPHICS FOR THE PREPARATION AND MANAGEMENT OF FINITE ELEMENT DATA  
HS-015 734
- Biss, D. J.**  
THE DEVELOPMENT OF AN AIR BAG ON COLLAPSIBLE DASHBOARD RESTRAINT SYSTEM FOR RIGHT FRONT SEAT OCCUPANTS  
HS-015 682
- Blakeley, M. R.**  
FLEXIBLE WORKING HOURS. A STUDY OF AN EXPERIMENT IN FLEXIBLE WORKING HOURS TO DETERMINE CHANGES IN TRAVEL PATTERNS  
HS-015 758
- Bonsteel, D. L.**  
PEDESTRIANS IN DOWNTOWN: OBSERVING PEOPLE IN THE BUILT ENVIRONMENT  
HS-015 828
- Boyer, R. C.**  
VEHICLE BRAKING SYSTEMS TEST PROCEDURE--HYDRAULIC BRAKES. FINAL REPORT  
HS-801 308
- Brammeier, G. F.**  
FRONT END STRUCTURES CRASH RESPONSE CHARACTERIZATION  
HS-015 677
- Brenner, F. C.**  
PATTERNS OF TREAD WEAR AND ESTIMATED TREAD LIFE  
HS-015 812
- Bronstad, M. E.**  
A BREAKAWAY CONCEPT FOR TIMBER UTILITY POLES  
HS-015 799  
  
CRASH TEST EVALUATION OF THREE BEAM TRAFFIC BARRIERS  
HS-015 796  
  
DEVELOPMENT OF A NEW MEDIAN BARRIER TERMINAL  
HS-015 795  
  
DEVELOPMENT OF APPROACH RAIL-BRIDGE RAIL TRANSITION USING ALUMINUM BALANCED SYSTEM  
HS-015 797

- Brooks, B. M.**  
AN INVESTIGATION OF FACTORS AFFECTING THE  
USE OF BUSES BY BOTH ELDERLY AND AMBU-  
LANT DISABLED PERSONS  
HS-015 669
- Brown, J. L.**  
DRUG EFFECTS ON VISION: STRATEGIES FOR  
STUDY AND SELECTED RESULTS  
HS-015 699
- Brown, R. G.**  
PROCEDURES AND TECHNIQUES FOR PHOTOMET-  
RIC MEASUREMENT OF GONIOMETER-MOUNTED  
SAE AND ECE HEADLAMPS  
HS-015 800
- Browne, A. L.**  
CONTOURING THE TIRE SIDEWALL WITH MOIRE  
HS-015 811  
TIRE DEFORMATION DURING DYNAMIC  
HYDROPLANING  
HS-015 755
- Bruce, R. W.**  
LARGE DISPLACEMENT, NONLINEAR TRANSIENT  
ANALYSIS BY FINITE ELEMENTS  
HS-015 724
- Buth, E.**  
CRASH TESTS AND EVALUATION OF SINGLE POST  
HIGHWAY SIGNS. INTERIM REPORT  
HS-015 782
- Button, J. W.**  
CRASH TESTS AND EVALUATION OF SINGLE POST  
HIGHWAY SIGNS. INTERIM REPORT  
HS-015 782
- Campbell, B. J.**  
DRIVER INJURY IN AUTOMOBILE ACCIDENTS IN-  
VOLVING CERTAIN CAR MODELS: AN UPDATE  
HS-015 668
- Campbell, K. L.**  
ENERGY BASIS FOR COLLISION SEVERITY  
HS-015 671
- Carnahan, J. E.**  
DWI LAW ENFORCEMENT TRAINING PROJECT.  
EVALUATION AIDS PACKET AND MEDIA LOG  
HS-801 345
- Carr, R. W.**  
IMPROVED RESTRAINT FOR U. S. ARMY AIR-  
CREWMEN  
HS-015 690
- Chen, K.-K.**  
STIFFNESS ANALYSIS OF SHEET METAL SHELLS  
UNDER CONCENTRATED LOADS  
HS-015 725
- Cleveland, D. E.**  
DETECTION OF FREEWAY CAPACITY-REDUCING  
INCIDENTS BY TRAFFIC-STREAM MEASUREMENTS  
HS-015 785
- Cole, C. W.**  
UNIFORM TIRE QUALITY GRADING TREADWEAR.  
FINAL REPORT  
HS-801 315
- Contini, E.**  
EMERGING OPPORTUNITIES FOR THE PEDESTRIAN  
ENVIRONMENT  
HS-015 825
- Cook, A. R.**  
DETECTION OF FREEWAY CAPACITY-REDUCING  
INCIDENTS BY TRAFFIC-STREAM MEASUREMENTS  
HS-015 785
- Cooley, P.**  
FIRE IN MOTOR VEHICLE ACCIDENTS  
HS-015 817
- Cope, E. M.**  
THE EFFECT OF SPEED ON TRUCK FUEL CON-  
SUMPTION RATES  
HS-015 756
- Costigan, D. M.**  
ELECTRIC CARS--SET FOR ANOTHER COMEBACK  
HS-015 748
- Cromack, J. R.**  
INJURY ASSESSMENT OF BELTED CADAVERS.  
PROGRESS REPORT NO. 4, OCTOBER 1974  
HS-801 375  
INJURY ASSESSMENT OF BELTED CADAVERS.  
PROGRESS REPORT NO. 3, SEPTEMBER 1974  
HS-801 376
- Cummings, G. F.**  
A NEW WET CLUTCH FAN DRIVE SYSTEM  
HS-015 821
- Dell'Amico, F.**  
THE INFLUENCE OF TIRE PROPERTIES ON PAS-  
SENGER VEHICLE HANDLING. VOL. 1.SUMMARY  
REPORT. FINAL REPORT  
HS-801 323  
THE INFLUENCE OF TIRE PROPERTIES ON PAS-  
SENGER VEHICLE HANDLING. VOL. 2. TECHNICAL  
REPORT. FINAL REPORT  
HS-801 324
- Derringer, G. C.**  
ANALYSIS OF THE WEAR OF MULTISECTIONED  
TIRE TREADS  
HS-015 813
- Dinkel, J.**  
SHOCK ABSORBERS FOR YOUR CAR. PT. 2:  
DYNAMOMETER, TRACK AND ROAD TESTS OF 10  
SHOCKS ON A CORVETTE  
HS-015 749
- Dreveskracht, C. L.**  
DWI LAW ENFORCEMENT TRAINING PROJECT.  
EVALUATION AIDS PACKET AND MEDIA LOG  
HS-801 345

- Dudek, C. L.**  
STUDY OF DETECTOR RELIABILITY FOR A MOTORIST INFORMATION SYSTEM ON THE GULF FREEWAY  
HS-015 787
- Dunlap, D. F.**  
LARGE-TRUCK ACCIDENTS INVOLVING TIRE FAILURE. FINAL REPORT  
HS-015 803
- Dutt, A. K.**  
STUDY OF DETECTOR RELIABILITY FOR A MOTORIST INFORMATION SYSTEM ON THE GULF FREEWAY  
HS-015 787
- DuVall, F. W.**  
FINITE ELEMENT STRUCTURAL ANALYSIS AS APPLIED TO AN AUTOMOTIVE DOOR STRUCTURE  
HS-015 710
- Elliott, W. A.**  
AN INTRODUCTION TO SCALE MODEL TESTING TO DETERMINE AIR CUSHION CRASH SENSOR LOCATION  
HS-015 691
- Enserink, E.**  
VEHICLE BRAKING SYSTEMS TEST PROCEDURE--HYDRAULIC BRAKES. FINAL REPORT  
HS-801 308
- Ervin, R. D.**  
BRAKING EFFICIENCY TEST TECHNIQUE. FINAL REPORT  
HS-801 352  
BRAKING EFFICIENCY TEST TECHNIQUE. SUMMARY REPORT  
HS-801 353
- Esselink, L.**  
USING INTERACTIVE GRAPHICS FOR THE PREPARATION AND MANAGEMENT OF FINITE ELEMENT DATA  
HS-015 734
- Everett, M.**  
COMMUTER DEMAND FOR BICYCLE TRANSPORTATION IN THE UNITED STATES  
HS-015 700
- Fawcett, D. J.**  
GENERATION OF FINITE ELEMENT MODELS VIA COMPUTER GRAPHICS  
HS-015 732
- Fensel, P. A.**  
AN AXISYMMETRIC FINITE ELEMENT ANALYSIS OF THE MECHANICAL AND THERMAL STRESSES in brake drums  
HS-015 711
- Fine, D. S.**  
STIFFNESS ANALYSIS OF SHEET METAL SHELLS UNDER CONCENTRATED LOADS  
HS-015 725
- Fitzpatrick, M.**  
INFLATABLE BELT DEVELOPMENT FOR SUBCOMPACT CAR PASSENGERS. PROGRESS REPORT, SEPTEMBER 1974  
HS-801 369
- Fleming, J. M.**  
DIESEL ENGINE COMPONENT DESIGN USING THE FINITE ELEMENT METHOD AND INTERACTIVE GRAPHICS  
HS-015 727
- Forsgate, J. A.**  
SPEED/FLOW RELATIONS ON RECREATIONAL ROADS  
HS-015 783
- Free, J. C.**  
AN INEXPENSIVE AUTOMOBILE CRASH RECORDER  
HS-015 673
- Friedman, D.**  
AN INEXPENSIVE AUTOMOBILE CRASH RECORDER  
HS-015 673  
AUTOMOBILES AND HIGHWAY CRASH ATTENUATORS: SYSTEM DESIGN CONSIDERATIONS  
HS-015 794  
SUBCOMPACT CAR CRASHWORTHINESS PROGRAM. PROGRESS REPORT, NOVEMBER 1974  
HS-801 377
- Fukushima, M.**  
FLUID CRASH SENSOR  
HS-015 681
- Gazis, D. C.**  
DESIGN OF DENSITY-MEASURING SYSTEMS FOR ROADWAYS  
HS-015 788
- Geissler, H.**  
FINITE ELEMENT ANALYSIS, AN AUTOMOBILE ENGINEER'S TOOL  
HS-015 728
- Gilliland, M. G.**  
APPLICATIONS OF COMPUTER-GENERATED IMAGERY TO DRIVER TRAINING; HIGHWAY RESEARCH, AND DESIGN  
HS-015 737  
SIMULATION: ITS ROLE IN DRIVER RESEARCH AND HIGHWAY DESIGN. VOL. 8  
HS-015 736
- Greene, J. E.**  
DEVELOPMENT AND EVALUATION OF A STRUCTURAL CRASHWORTHINESS SYSTEM FOR A STANDARD SIZE AUTOMOBILE. EXECUTIVE SUMMARY. FINAL REPORT  
HS-801 318
- Grey, A. L.**  
PEDESTRIANS IN DOWNTOWN: OBSERVING PEOPLE IN THE BUILT ENVIRONMENT  
HS-015 828
- Grow, N. L., Jr.**  
SIMULATION AND SIMULATORS: A SELECTED BIBLIOGRAPHY  
HS-015 740

- Gulash, E. C.**  
HUMAN VOLUNTEER AND ANTHROPOMORPHIC DUMMY TESTS OF GENERAL MOTORS DRIVER AIR CUSHION SYSTEM  
HS-015 684
- Gwilt, S. R.**  
PROCEDURES AND TECHNIQUES FOR PHOTOMETRIC MEASUREMENT OF GONIOMETER-MOUNTED SAE AND ECE HEADLAMPS  
HS-015 800
- Haisler, W. E.**  
SURVEY OF SOLUTION PROCEDURES FOR NON-LINEAR STATIC AND DYNAMIC ANALYSES  
HS-015 707
- Hammond, J. N.**  
SPEED/FLOW RELATIONS ON RECREATIONAL ROADS  
HS-015 783
- Harano, R. M.**  
AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. FINAL REPORT  
HS-015 781
- Harrison, A. L.**  
A PROCEDURE FOR THE PHOTOMETRIC DETERMINATION OF HEADLAMP AIM BY ISOLUX CONTOUR MATCHING  
HS-015 698
- Hayes, G. G.**  
VEHICLE-ARRESTING SYSTEM USING CHAIN-LINK FENCE  
HS-015 793
- Henderson, M. R.**  
THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY  
HS-015 694
- Hess, R. L.**  
DISCUSSION (THE HSRI DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY)  
HS-015 695
- Hilbrandt, E.**  
SCHWINGUNGSUNTERSUCHUNGEN AN EINER PKW-KAROSSERIE (INVESTIGATIONS INTO THE VIBRATIONS OF AN AUTOMOBILE BODY)  
HS-015 805
- Hillegas, B. D.**  
INVESTIGATION OF FLOW-DENSITY DISCONTINUITY AND DUAL-MODE TRAFFIC BEHAVIOR  
HS-015 789
- Hirsch, T. J.**  
CRASH TESTS AND EVALUATION OF SINGLE POST HIGHWAY SIGNS. INTERIM REPORT  
HS-015 782  
SIMULATION: ITS ROLE IN DRIVER RESEARCH AND HIGHWAY DESIGN. VOL. 8  
HS-015 736
- USE OF MATHEMATICAL SIMULATIONS TO DEVELOP SAFER HIGHWAY DESIGN CRITERIA**  
HS-015 739
- VEHICLE-ARRESTING SYSTEM USING CHAIN-LINK FENCE**  
HS-015 793
- Hirst, E.**  
BICYCLES, CARS AND ENERGY  
HS-015 701
- Holmes, B. S.**  
SCALE MODELING OF VEHICLE CRASHES--TECHNIQUES, APPLICABILITY, AND ACCURACY; COST EFFECTIVENESS  
HS-015 692
- Horowitz, J. M.**  
PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT (21ST), 1 MARCH TO 31 MARCH 1974  
HS-801 364  
PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT NO. 22, APRIL 1974  
HS-801 378
- Houghton, D. G.**  
INVESTIGATION OF FLOW-DENSITY DISCONTINUITY AND DUAL-MODE TRAFFIC BEHAVIOR  
HS-015 789
- Howell, L. J.**  
POWER SPECTRAL DENSITY ANALYSIS OF VEHICLE VIBRATION USING THE NASTRAN COMPUTER PROGRAM  
HS-015 718
- Hubbard, R. P.**  
THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY  
HS-015 694
- Hubert, D. E.**  
AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. FINAL REPORT  
HS-015 781
- Huston, R. L.**  
USER'S MANUAL FOR UCIN VEHICLE-OCCUPANT CRASH-STUDY MODEL  
HS-015 769
- Ikeda, S.**  
FLUID CRASH SENSOR  
HS-015 681
- Impeduglia, G.**  
AUTOMOBILE COLLISIONS. A MODULE ON ENERGY AND MOMENTUM  
HS-015 746
- Jackett, M. J.**  
FLEXIBLE WORKING HOURS. A STUDY OF AN EXPERIMENT IN FLEXIBLE WORKING HOURS TO DETERMINE CHANGES IN TRAVEL PATTERNS  
HS-015 758

May 31, 1975

- Jaeger, L. G.**  
THE ROLE OF FINITE DEFORMATION ANALYSIS IN  
PLANE STRESS AND STRAIN FRACTURES  
HS-015 722
- Jahnle, H. A.**  
FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE  
STRUCTURE. PROGRESS REPORT, SEPTEMBER 1974  
HS-801 362  
FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE  
STRUCTURE. PROGRESS REPORT, JUNE-JULY 1974  
HS-801 363  
FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE  
STRUCTURE. PROGRESS REPORT, DECEMBER 1974  
HS-801 370  
FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE  
STRUCTURE. PROGRESS REPORT, NOVEMBER 1974  
HS-801 371  
FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE  
STRUCTURE. PROGRESS REPORT, AUGUST 1974  
HS-801 372
- Jaworski, S. D.**  
DRIVE YOUR CAR SAFELY  
HS-015 814
- Jensen, R. H.**  
GM-ATD 502 ANTHROPOMORPHIC DUMMY-  
DEVELOPMENT AND EVALUATION  
HS-015 697
- Jones, T. O.**  
AN INTRODUCTION TO SCALE MODEL TESTING TO  
DETERMINE AIR CUSHION CRASH SENSOR LOCA-  
TION  
HS-015 691
- Jordan, A.**  
TEST SLED SIMULATION OF CRASH INDUCED YAW  
AND PITCH  
HS-015 693
- Kaestner, N. F.**  
THE IMPACT OF DRIVER IMPROVEMENT: DO WE  
REALLY WANT TO KNOW?  
HS-015 703
- Karnes, R. N.**  
A USER-ORIENTED PROGRAM FOR CRASH DYNAM-  
ICS  
HS-015 721
- Kataja, M.**  
EXAMINATION OF ALCOHOL INTOXICATION IN  
CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A  
MATHEMATICAL ANALYSIS OF THE RELATIONSHIP  
BETWEEN THE RESULTS OF CLINICAL EXAMINA-  
TION AND BLOOD ALCOHOL  
HS-015 784
- Kleinman, S.**  
ALGORITHM FOR A REAL-TIME ADVISORY SIGN  
CONTROL SYSTEM FOR URBAN HIGHWAYS  
HS-015 790
- Klosterman, A. L.**  
NASTRAN FOR DYNAMIC ANALYSIS OF VEHICLE  
SYSTEMS  
HS-015 716
- Kondo, A.**  
PATTERNS OF TREAD WEAR AND ESTIMATED  
TREAD LIFE  
HS-015 812
- Kyropoulos, P.**  
SIMULATION: ITS ROLE IN DRIVER RESEARCH AND  
HIGHWAY DESIGN. VOL. 8  
HS-015 736  
SIMULATORS: BOON OR BOONDOGGLE?  
HS-015 738
- Langwieder, K. O.**  
INFLUENCES ON THE DRIVING BEHAVIOR OF AU-  
TOMOBILES (EINFLUSSE AUF DAS FAHRVERHAL-  
TEN VON KRAFTFAHRZEUGEN)  
HS-015 702
- Larkin, L. A.**  
ELASTIC-PLASTIC PLATE BENDING WITH CON-  
STANT CURVATURE ELEMENTS  
HS-015 708
- Laurenson, C. G.**  
FLEXIBLE WORKING HOURS. A STUDY OF AN EX-  
PERIMENT IN FLEXIBLE WORKING HOURS TO  
DETERMINE CHANGES IN TRAVEL PATTERNS  
HS-015 758
- Leverenz, R. K.**  
USING INTERACTIVE GRAPHICS FOR THE  
PREPARATION AND MANAGEMENT OF FINITE ELE-  
MENT DATA  
HS-015 734
- Levinson, H. S.**  
PEDESTRIAN CIRCULATION PLANNING: PRINCI-  
PLES, PROCEDURES, PROTOTYPES  
HS-015 826
- Lintell, M.**  
THE ENVIRONMENTAL QUALITY OF CITY  
STREETS: THE RESIDENTS' VIEWPOINT  
HS-015 829
- Loverher, A.**  
FINITE ELEMENT MODEL DATA CHECKOUT WITH  
INTERACTIVE GRAPHICS  
HS-015 731
- Lubkin, J. L.**  
THE FLEXIBILITY OF A TUBULAR WELDED JOINT  
IN A VEHICLE FRAME  
HS-015 730
- Lutkefedder, N. W.**  
AUTOMOTIVE RECORDER RESEARCH--A SUMMARY  
OF ACCIDENT DATA AND TEST RESULTS  
HS-015 672
- Marquis, E. L.**  
VEHICLE-ARRESTING SYSTEM USING CHAIN-LINK  
FENCE  
HS-015 793
- May, A. D.**  
OPTIMIZATION TECHNIQUES APPLIED TO IMPROV-  
ING FREEWAY OPERATIONS  
HS-015 791



- May, R. L.**  
RTOR: WARRANTS AND BENEFITS. FINAL REPORT  
HS-015 752
- McClelland, W. A.**  
NASTRAN FOR DYNAMIC ANALYSIS OF VEHICLE SYSTEMS  
HS-015 716
- McNeice, G. M.**  
APPLICATION OF GRID SELECTION PROCEDURES FOR IMPROVED FINITE ELEMENT STRESS ANALYSIS  
HS-015 726
- Melosh, R. J.**  
FINITE ELEMENT ANALYSIS OF AUTOMOBILE STRUCTURES  
HS-015 709
- Melvin, J. W.**  
DISCUSSION (THE HSRI DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY)  
HS-015 695  
FABRICATION OF A STANDARD BENCH VEHICLE SEAT. FINAL REPORT  
HS-801 384
- Mertz, H. J.**  
THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY  
HS-015 694
- Messer, C. J.**  
STUDY OF DETECTOR RELIABILITY FOR A MOTORIST INFORMATION SYSTEM ON THE GULF FREEWAY  
HS-015 787
- Michie, J. D.**  
A BREAKAWAY CONCEPT FOR TIMBER UTILITY POLES  
HS-015 799  
CRASH TEST EVALUATION OF THREE BEAM TRAFFIC BARRIERS  
HS-015 796  
DEVELOPMENT OF A NEW MEDIAN BARRIER TERMINAL  
HS-015 795  
DEVELOPMENT OF APPROACH RAIL-BRIDGE RAIL TRANSITION USING ALUMINUM BALANCED SYSTEM  
HS-015 797
- Miller, D. P.**  
TESTS FOR HAZARDOUS FAILURE OF ENERGY ABSORBING AUTOMOTIVE BUMPER CYLINDERS. REPORT  
HS-015 802
- Miller, J. M.**  
THE USE OF HUMAN SUBJECTS IN HUMAN FACTORS RESEARCH  
HS-015 704
- Miller, P. M.**  
CRASH ENERGY MANAGEMENT IN SUBCOMPACT AUTOMOBILES  
HS-015 678  
DEVELOPMENT AND EVALUATION OF A STRUCTURAL CRASHWORTHINESS SYSTEM FOR A STANDARD SIZE AUTOMOBILE. EXECUTIVE SUMMARY. FINAL REPORT  
HS-801 318
- Mohan, D.**  
HUMAN CHEST IMPACT PROTECTION CRITERIA  
HS-015 696
- Morgan, R. M.**  
THE EFFORTS OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION IN THE DEVELOPMENT OF ADVANCED PASSIVE PROTECTION SYSTEMS AND CHILD RESTRAINT SYSTEMS  
HS-015 686
- Nagy, L. I.**  
STATIC ANALYSIS VIA SUBSTRUCTURING OF AN EXPERIMENTAL VEHICLE FRONT-END BODY STRUCTURE  
HS-015 713
- Neathery, R. F.**  
THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY  
HS-015 694
- Nelson, M. F.**  
THE USE OF CONDENSATION TECHNIQUES FOR SOLVING DYNAMICS PROBLEMS  
HS-015 720
- Ng, B. L.**  
USING INTERACTIVE GRAPHICS FOR THE PREPARATION AND MANAGEMENT OF FINITE ELEMENT DATA  
HS-015 734
- Nguyen, T.**  
THE EFFECT ON TRAFFIC ACCIDENTS OF EXTENDED TRADING HOURS AT HOTELS  
HS-015 760
- Nicholson, D. W.**  
COMPRESSION OF AN INFLATED TUBE BETWEEN RIGID SURFACES AS AN ELEMENTARY TIRE MECHANICS MODEL  
HS-015 810
- Nolan, W. J.**  
IMPROVED RESTRAINT FOR U. S. ARMY AIRCREWMEN  
HS-015 690
- Nonaka, K.**  
FLUID CRASH SENSOR  
HS-015 681
- Norbet, W. J.**  
A CONTEMPORARY OVERVIEW OF TRAFFIC LAW UNIFORMITY IN THE UNITED STATES. A STUDY

May 31, 1975

- PREPARED ON RULES OF THE ROAD UNIFORMITY  
IN THE TRAFFIC LAWS OF THE SEVERAL STATES  
HS-820 262
- O'Day, J.**  
A PROPOSED NEW NATIONAL SYSTEM FOR COL-  
LECTING MULTIPURPOSE ACCIDENT DATA: SIR  
HS-015 757  
IN-DEPTH ACCIDENT DATA AND OCCUPANT PRO-  
TECTION--A STATISTICAL POINT OF VIEW  
HS-015 675
- Oates, J. F. , Jr.**  
IDENTIFICATION OF COUNTERMEASURES FOR THE  
YOUTH CRASH PROBLEM RELATED TO ALCOHOL.  
FINAL REPORT  
HS-801 344
- Oh, H. L.**  
THE COMPUTATION OF TEARING ENERGY OF  
NICKED RUBBER STRIPS IN EXTENSION  
HS-015 715
- Orban, M. S.**  
IDENTIFICATION OF COUNTERMEASURES FOR THE  
YOUTH CRASH PROBLEM RELATED TO ALCOHOL.  
FINAL REPORT  
HS-801 344
- Paddock, R. D.**  
THE TRAFFIC CONFLICTS TECHNIQUE: AN AC-  
CIDENT PREDICTION METHOD  
HS-015 801
- Palmer, M. R.**  
AN ANALYSIS OF TRAFFIC ACCIDENTS IN NEW  
ZEALAND  
HS-015 759
- Park, K. C.**  
AN INTERACTIVE HYBRID TECHNIQUE FOR  
CRASHWORTHY DESIGN OF COMPLEX VEHICULAR  
STRUCTURAL SYSTEMS  
HS-015 717
- Park, S. W.**  
FINITE ELEMENT STRUCTURAL ANALYSIS AS AP-  
PLIED TO AN AUTOMOTIVE DOOR STRUCTURE  
HS-015 710
- Passerello, C. E.**  
USER'S MANUAL FOR UCIN VEHICLE-OCCUPANT  
CRASH-STUDY MODEL  
HS-015 769
- Pavlick, M. J.**  
DEVELOPMENT OF ENERGY ABSORBING AUTOMO-  
TIVE STRUCTURES USING SCALE MODEL TEST  
TECHNIQUES  
HS-015 676
- Pearce, S. J.**  
AUTOMOTIVE RECORDER RESEARCH--A SUMMARY  
OF ACCIDENT DATA AND TEST RESULTS  
HS-015 672
- Penttila, A.**  
EXAMINATION OF ALCOHOL INTOXICATION IN  
CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A  
MATHEMATICAL ANALYSIS OF THE RELATIONSHIP  
BETWEEN THE RESULTS OF CLINICAL EXAMINA-  
TION AND BLOOD ALCOHOL  
HS-015 784
- Percy, M. J.**  
DIESEL ENGINE COMPONENT DESIGN USING THE  
FINITE ELEMENT METHOD AND INTERACTIVE  
GRAPHICS  
HS-015 727
- Periard, A. R.**  
USING INTERACTIVE GRAPHICS FOR THE  
PREPARATION AND MANAGEMENT OF FINITE ELE-  
MENT DATA  
HS-015 734
- Petrof, R. C.**  
ELASTO-PLASTIC ANALYSIS OF STRESS IN A GAS-  
TURBINE WHEEL  
HS-015 723
- Pierce, B. F.**  
SOURCES AND REMEDIES FOR RESTRAINT SYSTEM  
DISCOMFORT AND INCONVENIENCES. FINAL  
BRIEFING  
HS-801 374
- Pierce, I. N.**  
NEED FOR A PLANNED PEDESTRIAN ENVIRON-  
MENT: THE PHILADELPHIA EXPERIENCE  
HS-015 827
- Post, E. R.**  
FULL-SCALE EMBANKMENT TESTS AND COM-  
PARISONS WITH A COMPUTER SIMULATION  
HS-015 798
- Potter, R. A.**  
GM-ATD 502 ANTHROPOMORPHIC DUMMY--  
DEVELOPMENT AND EVALUATION  
HS-015 697
- Preusser, D. F.**  
IDENTIFICATION OF COUNTERMEASURES FOR THE  
YOUTH CRASH PROBLEM RELATED TO ALCOHOL.  
FINAL REPORT  
HS-801 344
- Radaj, D.**  
FINITE ELEMENT ANALYSIS, AN AUTOMOBILE EN-  
GINEER'S TOOL  
HS-015 728
- Reese, G. H.**  
PERFORMANCE OF VOLUNTEER MONITORS USING  
CITIZENS BAND RADIO FOR A HIGHWAY COMMU-  
NICATIONS SERVICE  
HS-015 786
- Retzko, H.-G.**  
PEDESTRIAN BEHAVIOR AT SIGNALISED INTER-  
SECTIONS  
HS-015 765
- Rice, R. S.**  
THE INFLUENCE OF TIRE PROPERTIES ON PAS-  
SENGER VEHICLE HANDLING. VOL. 1.SUMMARY  
REPORT. FINAL REPORT  
HS-801 323

- THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 2. TECHNICAL REPORT. FINAL REPORT  
HS-801 324
- Robertson, L. S.**  
FACTORS ASSOCIATED WITH SAFETY BELT USE IN 1974 STARTER-INTERLOCK EQUIPPED CARS  
HS-015 815  
HOW DRIVERS PREVENTED FROM DRIVING WOULD REACH WORK: IMPLICATIONS FOR PENALTIES  
HS-015 816
- Rockwell, T. H.**  
THE USE OF HUMAN SUBJECTS IN HUMAN FACTORS RESEARCH  
HS-015 704
- Rodeheaver, K. D.**  
UNIFORM TIRE QUALITY GRADING TREADWEAR. FINAL REPORT  
HS-801 315
- Roland, R. D.**  
THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 1. SUMMARY REPORT. FINAL REPORT  
HS-801 323  
THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 2. TECHNICAL REPORT. FINAL REPORT  
HS-801 324
- Roshala, J. L.**  
TESTING CRASH DUMMIES  
HS-015 753
- Ross, G. F.**  
BARBI, A NEW RADAR CONCEPT FOR PRECOLLISION SENSING  
HS-015 680
- Ross, H. L.**  
INTERRUPTED TIME-SERIES METHODS FOR THE EVALUATION OF TRAFFIC LAW REFORMS  
HS-015 705
- Ross, H.E., Jr.**  
FULL-SCALE EMBANKMENT TESTS AND COMPARISONS WITH A COMPUTER SIMULATION  
HS-015 798
- Ruffell-Smith, H. P.**  
AN INVESTIGATION OF FACTORS AFFECTING THE USE OF BUSES BY BOTH ELDERLY AND AMBULANT DISABLED PERSONS  
HS-015 669
- Russell, E. R.**  
ANALYSIS OF DRIVER REACTION TO WARNING DEVICES AT A HIGH-ACCIDENT RURAL GRADE CROSSING. FINAL REPORT  
HS-015 750
- Ryba, D.**  
IMPROVEMENT IN DYNAMIC CHARACTERISTICS OF AUTOMOBILE SUSPENSION SYSTEMS. PT. 2. THREE-MASS SYSTEMS  
HS-015 804
- Ryder, M. O., Jr.**  
CRASH ENERGY MANAGEMENT IN SUBCOMPACT AUTOMOBILES  
HS-015 678
- Saczalski, K. J.**  
AN INTERACTIVE HYBRID TECHNIQUE FOR CRASHWORTHY DESIGN OF COMPLEX VEHICULAR STRUCTURAL SYSTEMS  
HS-015 717
- Satoh, S.**  
STUDY ON AIR BAG SYSTEMS FOR NISSAN SMALL-SIZED CARS  
HS-015 683
- Schimkat, H. J.**  
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE CRASHWORTHINESS OF SMALL CARS  
HS-015 679
- Schwanz, W.**  
PERFORMANCE MATRICES OF FOUR RESTRAINT SYSTEMS  
HS-015 689
- Schwerzler, D. D.**  
A TECHNIQUE FOR CONNECTING BEAM ELEMENTS TO A PLATE MODEL OF A COMPLICATED BOX SECTION  
HS-015 729
- Sebastian, J. D.**  
A USER-ORIENTED PROGRAM FOR CRASH DYNAMICS  
HS-015 721
- Seiffert, U.**  
PERFORMANCE MATRICES OF FOUR RESTRAINT SYSTEMS  
HS-015 689
- Shaw, L. M.**  
FRONT END STRUCTURES CRASH RESPONSE CHARACTERIZATION  
HS-015 677
- Shoemaker, N. E.**  
CRASH ENERGY MANAGEMENT IN SUBCOMPACT AUTOMOBILES  
HS-015 678  
THE DEVELOPMENT OF AN AIR BAG ON COLLAPSIBLE DASHBOARD RESTRAINT SYSTEM FOR RIGHT FRONT SEAT OCCUPANTS  
HS-015 682
- Sliter, G.**  
SCALE MODELING OF VEHICLE CRASHES--TECHNIQUES, APPLICABILITY, AND ACCURACY; COST EFFECTIVENESS  
HS-015 692
- Smith, G. R.**  
HUMAN VOLUNTEER AND ANTHROPOMORPHIC DUMMY TESTS OF GENERAL MOTORS DRIVER AIR CUSHION SYSTEM  
HS-015 684

May 31, 1975

- Smith, W. H.**  
COMPOSITE MATERIALS IN AUTOMOBILE SIDE  
STRUCTURES--FEASIBILITY EVALUATION.  
MONTHLY LETTER REPORT NO. 13, JUNE 1974  
HS-801 365
- COMPOSITE MATERIALS IN AUTOMOBILE SIDE  
STRUCTURES--FEASIBILITY EVALUATION.  
MONTHLY LETTER REPORT NO. 14, JULY 1974  
HS-801 373
- Soboleski, J. J.**  
NASTRAN PLOTTING AT A REMOTE TERMINAL  
HS-015 733
- Stalnaker, R. L.**  
FABRICATION OF A STANDARD BENCH VEHICLE  
SEAT. FINAL REPORT  
HS-801 384
- HUMAN CHEST IMPACT PROTECTION CRITERIA  
HS-015 696
- Sternlicht, B.**  
WHICH AUTOMOTIVE ENGINES IN THE FUTURE?  
HS-015 820
- Strassenburg, A. A.**  
AUTOMOBILE COLLISIONS. A MODULE ON ENER-  
GY AND MOMENTUM  
HS-015 746
- Stricklin, J. A.**  
SURVEY OF SOLUTION PROCEDURES FOR NON-  
LINEAR STATIC AND DYNAMIC ANALYSES  
HS-015 707
- Strother, C. E.**  
THE EFFORTS OF THE NATIONAL HIGHWAY TRAF-  
FIC SAFETY ADMINISTRATION IN THE DEVELOP-  
MENT OF ADVANCED PASSIVE PROTECTION  
SYSTEMS AND CHILD RESTRAINT SYSTEMS  
HS-015 686
- Szeto, M. W.**  
DESIGN OF DENSITY-MEASURING SYSTEMS FOR  
ROADWAYS  
HS-015 788
- Takada, J.**  
DEVELOPMENT OF ENERGY-ABSORBING SAFETY  
BELT WEBBING  
HS-015 687
- Tang, S. C.**  
ELASTO-PLASTIC ANALYSIS OF STRESS IN A GAS-  
TURBINE WHEEL  
HS-015 723
- Tanner, R. B.**  
SUBCOMPACT CAR CRASHWORTHINESS PROGRAM.  
PROGRESS REPORT, SEPTEMBER 1974  
HS-801 361
- SUBCOMPACT CAR CRASHWORTHINESS PROGRAM.  
PROGRESS REPORT, AUGUST 1974  
HS-801 367
- SUBCOMPACT CAR CRASHWORTHINESS PROGRAM.  
PROGRESS REPORT, JULY 1974  
HS-801 368
- Teel, S. S.**  
AUTOMOTIVE RECORDER RESEARCH--A SUMMARY  
OF ACCIDENT DATA AND TEST RESULTS  
HS-015 672
- Tenhu, M.**  
EXAMINATION OF ALCOHOL INTOXICATION IN  
CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A  
MATHEMATICAL ANALYSIS OF THE RELATIONSHIP  
BETWEEN THE RESULTS OF CLINICAL EXAMINA-  
TION AND BLOOD ALCOHOL  
HS-015 784
- Tennant, J. A.**  
GM-ATD 502 ANTHROPOMORPHIC DUMMY--  
DEVELOPMENT AND EVALUATION  
HS-015 697
- Tocher, J. L.**  
A USER-ORIENTED PROGRAM FOR CRASH DYNAM-  
ICS  
HS-015 721
- Toomath, J. B.**  
THE EFFECT ON TRAFFIC ACCIDENTS OF EX-  
TENDED TRADING HOURS AT HOTELS  
HS-015 760
- Trabold, W. G.**  
PERFORMANCE OF VOLUNTEER MONITORS USING  
CITIZENS BAND RADIO FOR A HIGHWAY COMMU-  
NICATIONS SERVICE  
HS-015 786
- Turcke, D. J.**  
APPLICATION OF GRID SELECTION PROCEDURES  
FOR IMPROVED FINITE ELEMENT STRESS ANALY-  
SIS  
HS-015 726
- Twigg, D. W.**  
A USER-ORIENTED PROGRAM FOR CRASH DYNAM-  
ICS  
HS-015 721
- Vail, C. F.**  
A MODAL SYNTHESIS TECHNIQUE FOR DETERMIN-  
ING DYNAMIC PROPERTIES FOR A STRUCTURE FOR  
MASS AND STIFFNESS CHANGES  
HS-015 719
- Viner, J. G.**  
CRASH TEST EVALUATION OF THREE BEAM TRAF-  
FIC BARRIERS  
HS-015 796
- Wadleigh, K. H.**  
APPLICATION OF FINITE ELEMENT METHODS TO  
COMPLETE AUTOMOBILE STRUCTURAL DESIGN  
EVALUATION  
HS-015 712
- Walker, G. W.**  
ANGLE AND SMALL-CAR IMPACT TESTS OF AN AR-  
TICULATED GORE BARRIER EMPLOYING  
LIGHTWEIGHT CONCRETE ENERGY-ABSORBING  
CARTRIDGES  
HS-015 792

**Waller, P. F. , ed.**

SIMULATION: ITS ROLE IN DRIVER RESEARCH AND  
HIGHWAY DESIGN. VOL. 8

HS-015 736

**Wanderer, U. N.**

FIRST RESULTS OF EXACT ACCIDENT DATA  
ACQUISITION ON SCENE

HS-015 674

**Wang, N. -M.**

THE COMPUTATION OF TEARING ENERGY OF  
NICKED RUBBER STRIPS IN EXTENSION

HS-015 715

**Ward, J. S.**

AN INVESTIGATION OF FACTORS AFFECTING THE  
USE OF BUSES BY BOTH ELDERLY AND AMBU-  
LANT DISABLED PERSONS

HS-015 669

**Warner, C. Y.**

AN INEXPENSIVE AUTOMOBILE CRASH RECORDER

HS-015 673

ANGLE AND SMALL-CAR IMPACT TESTS OF AN AR-  
TICULATED GORE BARRIER EMPLOYING  
LIGHTWEIGHT CONCRETE ENERGY-ABSORBING  
CARTRIDGES

HS-015 792

AUTOMOBILES AND HIGHWAY CRASH ATTENUA-  
TORS: SYSTEM DESIGN CONSIDERATIONS

HS-015 794

**Weber, H. M.**

FIRST RESULTS OF EXACT ACCIDENT DATA  
ACQUISITION ON SCENE

HS-015 674

**Weiner, A. N.**

ALL ABOUT CATALYTIC CONVERTERS. HOW THEY  
WORK AND WHAT YOU CAN EXPECT IN PER-  
FORMANCE

HS-015 767

**Welch, R. E.**

LARGE DISPLACEMENT, NONLINEAR TRANSIENT  
ANALYSIS BY FINITE ELEMENTS

**Wiener, R.**

ALGORITHM FOR A REAL-TIME ADVISORY SIGN  
CONTROL SYSTEM FOR URBAN HIGHWAYS

HS-015 790

**Wilcox, B.**

AN INEXPENSIVE AUTOMOBILE CRASH RECORDER

HS-015 673

**Winkler, C. B.**

BRAKING EFFICIENCY TEST TECHNIQUE. FINAL  
REPORT

HS-801 352

BRAKING EFFICIENCY TEST TECHNIQUE. SUMMA-  
RY REPORT

HS-801 353

**Wolfe, G. K.**

A BREAKAWAY CONCEPT FOR TIMBER UTILITY  
POLES

HS-015 799

**Wong, J.**

A BREAKAWAY CONCEPT FOR TIMBER UTILITY  
POLES

HS-015 799

**Young, B. O.**

ANGLE AND SMALL-CAR IMPACT TESTS OF AN AR-  
TICULATED GORE BARRIER EMPLOYING  
LIGHTWEIGHT CONCRETE ENERGY-ABSORBING  
CARTRIDGES

HS-015 792

**Youssef, A.**

THE ROLE OF FINITE DEFORMATION ANALYSIS IN  
PLANE STRESS AND STRAIN FRACTURES

HS-015 722

**Zimmer, A.**

FINITE ELEMENT ANALYSIS, AN AUTOMOBILE EN-  
GINEER'S TOOL

HS-015 728

**Zylman, R.**

DRINKING AND DRIVING AFTER IT'S LEGAL TO  
DRINK AT 18

HS-015 747

## Corporate Author Index

- A. O. Smith Corp., Milwaukee, Wis.**  
ELASTIC-PLASTIC PLATE BENDING WITH CONSTANT CURVATURE ELEMENTS  
HS-015 708
- NASTRAN PLOTTING AT A REMOTE TERMINAL  
HS-015 733
- THE USE OF ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS IN THE CALCULATION OF CUMULATIVE FATIGUE DAMAGE  
HS-015 714
- Advanced Systems Development Section, Los Angeles Police Dept.**  
TRAFFIC INFORMATION SYSTEM. PHASE 3. FINAL REPORT  
HS-015 776
- American Automobile Assoc., Washington, D. C. Traf. Engineering and Safety Dept.**  
TRAILER POINTERS AND DRIVING HINTS FOR PASSENGER CAR OWNERS  
HS-015 761
- Army Air Mobility Res. and Devel. Lab.**  
IMPROVED RESTRAINT FOR U. S. ARMY AIRCREWMEN  
HS-015 690
- Asahi Chemical Industry Co. Ltd.**  
FLUID CRASH SENSOR  
HS-015 681
- Boeing Computer Services, Inc., Seattle, Wash.**  
A USER-ORIENTED PROGRAM FOR CRASH DYNAMICS  
HS-015 721
- Brigham Young Univ., Provo, Utah**  
AN INEXPENSIVE AUTOMOBILE CRASH RECORDER  
HS-015 673
- British Leyland U. K. Ltd., England Truck and Bus Div.**  
AN INVESTIGATION OF FACTORS AFFECTING THE USE OF BUSES BY BOTH ELDERLY AND AMBULANT DISABLED PERSONS  
HS-015 669
- Budd Co.**  
DEVELOPMENT OF ENERGY ABSORBING AUTOMOTIVE STRUCTURES USING SCALE MODEL TEST TECHNIQUES  
HS-015 676
- Budd Co., Technical Center, 300 Commerce Dr., Ft. Washington, Pa.**  
FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, SEPTEMBER 1974  
HS-801 362
- FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, JUNE-JULY 1974  
HS-801 363
- Budd Co., 300 Commerce Dr., Ft. Washington, Pa. 19034**  
FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, DECEMBER 1974  
HS-801 370
- FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, NOVEMBER 1974  
HS-801 371
- FEASIBILITY STUDY OF PLASTIC AUTOMOTIVE STRUCTURE. PROGRESS REPORT, AUGUST 1974  
HS-801 372
- California Dept. of Motor Vehicles, Res. and Statistics Section, P. O. Box 1828, Sacramento, CA 95809**  
AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. FINAL REPORT  
HS-015 781
- California Dept. of Motor Vehicles, Sacramento, Res. and Statistics Section**  
AN EVALUATION OF CALIFORNIA'S "GOOD DRIVER" INCENTIVE PROGRAM. ABSTRACT  
HS-015 780
- Calspan Corp.**  
CRASH ENERGY MANAGEMENT IN SUBCOMPACT AUTOMOBILES  
HS-015 678
- THE DEVELOPMENT OF AN AIR BAG ON COLLAPSIBLE DASHBOARD RESTRAINT SYSTEM FOR RIGHT FRONT SEAT OCCUPANTS  
HS-015 682
- Calspan Corp., Buffalo, N. Y.**  
THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 2. TECHNICAL REPORT. FINAL REPORT  
HS-801 324
- Calspan Corp., Buffalo, N. Y. 14221**  
PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT (21ST), 1 MARCH TO 31 MARCH 1974  
HS-801 364
- PRODUCTION FEASIBILITY--CRASHWORTHINESS STRUCTURE. FULL SIZE CARS. PHASE 1. PROGRESS REPORT NO. 22, APRIL 1974  
HS-801 378
- Calspan Corp., 4455 Genesee St., Buffalo, N. Y. 14221**  
DEVELOPMENT AND EVALUATION OF A STRUCTURAL CRASHWORTHINESS SYSTEM FOR A STANDARD SIZE AUTOMOBILE. EXECUTIVE SUMMARY. FINAL REPORT  
HS-801 318
- THE INFLUENCE OF TIRE PROPERTIES ON PASSENGER VEHICLE HANDLING. VOL. 1. SUMMARY REPORT. FINAL REPORT  
HS-801 323
- Central Organization for Traffic Safety in Finland**  
EXAMINATION OF ALCOHOL INTOXICATION IN CASES OF SUSPECTED DRUNKEN DRIVERS, 2. A MATHEMATICAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE RESULTS OF CLINICAL EXAMINATION AND BLOOD ALCOHOL  
HS-015 784

- Chrysler Corp.**  
APPLICATION OF FINITE ELEMENT METHODS TO COMPLETE AUTOMOBILE STRUCTURAL DESIGN EVALUATION  
HS-015 712
- Cosmopolitan Driver Training School, 5124 W. Sunnyside Ave., Chicago, Ill. 60630**  
DRIVE YOUR CAR SAFELY  
HS-015 814
- Cummins Engine Co., Inc.**  
DIESEL ENGINE COMPONENT DESIGN USING THE FINITE ELEMENT METHOD AND INTERACTIVE GRAPHICS  
HS-015 727
- Daimler-Benz A. G., Stuttgart (West Germany)**  
FINITE ELEMENT ANALYSIS, AN AUTOMOBILE ENGINEER'S TOOL  
HS-015 728
- Dayton-Walther Corp.**  
AN AXISYMMETRIC FINITE ELEMENT ANALYSIS OF THE MECHANICAL AND THERMAL STRESSES in brake drums  
HS-015 711
- Denver Univ.**  
INTERRUPTED TIME-SERIES METHODS FOR THE EVALUATION OF TRAFFIC LAW REFORMS  
HS-015 705
- Department of Civil Technology, Conestoga Coll. of Applied Arts and Technology (Canada)**  
APPLICATION OF GRID SELECTION PROCEDURES FOR IMPROVED FINITE ELEMENT STRESS ANALYSIS  
HS-015 726
- Department of Transp., Washington, D. C.**  
POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. REPORT TO THE CONGRESS  
HS-015 768
- Dunlap and Associates, Inc., Darien, Conn.**  
IDENTIFICATION OF COUNTERMEASURES FOR THE YOUTH CRASH PROBLEM RELATED TO ALCOHOL. FINAL REPORT  
HS-801 344
- Environmental Protection Agency, Washington, D. C.**  
POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. REPORT TO THE CONGRESS  
HS-015 768
- Federal Hwy. Administration, Washington, D. C.**  
MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS. PT. 7: TRAFFIC CONTROLS FOR SCHOOL AREAS  
HS-015 822
- THE EFFECT OF SPEED ON TRUCK FUEL CONSUMPTION RATES  
HS-015 756
- Ford Motor Co., Dearborn, Mich.**  
FINITE ELEMENT MODEL DATA CHECKOUT WITH INTERACTIVE GRAPHICS  
HS-015 731
- GENERATION OF FINITE ELEMENT MODELS VIA COMPUTER GRAPHICS  
HS-015 732
- STATIC ANALYSIS VIA SUBSTRUCTURING OF AN EXPERIMENTAL VEHICLE FRONT-END BODY STRUCTURE  
HS-015 713
- THE FLEXIBILITY OF A TUBULAR WELDED JOINT IN A VEHICLE FRAME  
HS-015 730
- Ford Motor Co., Scientific Res. Staff**  
ELASTO-PLASTIC ANALYSIS OF STRESS IN A GAS-TURBINE WHEEL  
HS-015 723
- Ford Motor Co, Dearborn, Mich. Body Engineering Office**  
FINITE ELEMENT STRUCTURAL ANALYSIS AS APPLIED TO AN AUTOMOTIVE DOOR STRUCTURE  
HS-015 710
- General Environments Corp., 6840 Industrial Rd., Springfield, Va. 22151**  
TESTS FOR HAZARDOUS FAILURE OF ENERGY ABSORBING AUTOMOTIVE BUMPER CYLINDERS. REPORT  
HS-015 802
- General Motors Corp. Engineering Staff, Warren, Mich.**  
AN INTRODUCTION TO SCALE MODEL TESTING TO DETERMINE AIR CUSHION CRASH SENSOR LOCATION  
HS-015 691
- General Motors Corp. Res. Labs. and Mfg. Staff**  
USING INTERACTIVE GRAPHICS FOR THE PREPARATION AND MANAGEMENT OF FINITE ELEMENT DATA  
HS-015 734
- General Motors Corp., Res. Labs., Warren, Mich.**  
TIRE DEFORMATION DURING DYNAMIC HYDROPLANING  
HS-015 755
- General Motors Corp., Research Labs. and Chevrolet Motor Div.**  
STIFFNESS ANALYSIS OF SHEET METAL SHELLS UNDER CONCENTRATED LOADS  
HS-015 725
- General Motors Corp., Warren, Mich. Environmental Activities Staff**  
ENERGY BASIS FOR COLLISION SEVERITY  
HS-015 671
- HUMAN VOLUNTEER AND ANTHROPOMORPHIC DUMMY TESTS OF GENERAL MOTORS DRIVER AIR CUSHION SYSTEM  
HS-015 684
- THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY  
HS-015 694

May 31, 1975

**General Motors Engineering Staff, Warren, Mich.**  
GM-ATD 502 ANTHROPOMORPHIC DUMMY--  
DEVELOPMENT AND EVALUATION

HS-015 697

**General Motors Research Labs., Warren, Mich.**  
A MODAL SYNTHESIS TECHNIQUE FOR DETERMINING DYNAMIC PROPERTIES FOR A STRUCTURE FOR MASS AND STIFFNESS CHANGES

HS-015 719

A TECHNIQUE FOR CONNECTING BEAM ELEMENTS TO A PLATE MODEL OF A COMPLICATED BOX SECTION

HS-015 729

POWER SPECTRAL DENSITY ANALYSIS OF VEHICLE VIBRATION USING THE NASTRAN COMPUTER PROGRAM

HS-015 718

THE COMPUTATION OF TEARING ENERGY OF NICKED RUBBER STRIPS IN EXTENSION

HS-015 715

THE HIGHWAY SAFETY RESEARCH INSTITUTE DUMMY COMPARED WITH GENERAL MOTORS BIOFIDELITY RECOMMENDATIONS AND THE HYBRID 2 DUMMY

HS-015 694

THE USE OF CONDENSATION TECHNIQUES FOR SOLVING DYNAMICS PROBLEMS

HS-015 720

**Highway Loss Data Inst., Watergate 600, Washington, D. C. 20037**

AUTOMOBILE INSURANCE LOSSES COLLISION COVERAGES. RELATIONSHIPS BETWEEN LOSSES AND VEHICLE DENSITY, 1972 AND 1973 MODELS

HS-015 735

**Highway Safety Res. Inst., Huron Parkway & Baxter Road, Univ. of Mich., Ann Arbor, Mich. 48105**  
LARGE-TRUCK ACCIDENTS INVOLVING TIRE FAILURE. FINAL REPORT

HS-015 803

**Highway Users Federation for Safety and Mobility, Washington, D. C.**

ACCIDENT STUDY RAISES QUESTIONS ON 55 MPH NATIONAL SPEED LIMIT

HS-015 764

**Hwy Safety Res. Inst., Univ. of Michigan, Huron Pkwy. & Baxter Rd., Ann Arbor, Mich. 48105**  
BRAKING EFFICIENCY TEST TECHNIQUE. FINAL REPORT

HS-801 352

**Hwy. Safety Res. Inst., Univ. of Michigan, Ann Arbor 48105**

FABRICATION OF A STANDARD BENCH VEHICLE SEAT. FINAL REPORT

HS-801 384

DATA FROM FABRICATION OF A STANDARD BENCH VEHICLE SEAT. APPENDIX C

HS-801 385

BELT RETRACTOR TESTING WITH STANDARD VEHICLE SEAT. APPENDIX D. MODIFICATION 1.

HS-801 386

**Hwy. Safety Res. Inst., Univ. of Michigan, Huron Pkwy. & Baxter Rd., Ann Arbor, Mich. 48105**  
BRAKING EFFICIENCY TEST TECHNIQUE. SUMMARY REPORT

HS-801 353

**Illinois Univ., Chicago**  
LARGE DISPLACEMENT, NONLINEAR TRANSIENT ANALYSIS BY FINITE ELEMENTS

HS-015 724

**Inst. for Research in Public Safety, Indiana Univ., 400 East Seventh St., Bloomington, Ind. 47401**  
TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS. VOL. 1--RESEARCH FINDINGS. FINAL REPORT

HS-801 334

TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS: INTERIM REPORT I. VOL. 2--APPENDICES.

HS-801 335

**Institute of Automotive Engineering, Berlin Technical Univ.**  
A FORCE LIMITING SYSTEM ON A THREE-POINT-BELT SYSTEM DEPENDING ON CRASH VELOCITY

HS-015 688

**Insurance Inst. for Highway Safety, Washington, D. C.**  
FACTORS ASSOCIATED WITH SAFETY BELT USE IN 1974 STARTER-INTERLOCK EQUIPPED CARS

HS-015 815

**Insurance Inst. for Hwy. Safety, Washington, D. C.**  
HOW DRIVERS PREVENTED FROM DRIVING WOULD REACH WORK: IMPLICATIONS FOR PENALTIES

HS-015 816

**Inter-Ministerial Com. on Drinking and Driving, Ontario, Canada**  
DRINKING-DRIVING IN THE PROVINCE OF ONTARIO

HS-015 824

**IIT Research Inst., Chicago, Ill.**  
LARGE DISPLACEMENT, NONLINEAR TRANSIENT ANALYSIS BY FINITE ELEMENTS

HS-015 724

**IIT Research Inst., 10 West 35 St., Chicago, Ill. 60616**  
COMPOSITE MATERIALS IN AUTOMOBILE SIDE STRUCTURES--FEASIBILITY EVALUATION. MONTHLY LETTER REPORT NO. 13, JUNE 1974

HS-801 365

COMPOSITE MATERIALS IN AUTOMOBILE SIDE STRUCTURES--FEASIBILITY EVALUATION. MONTHLY LETTER REPORT NO. 14, JULY 1974

HS-801 373

**Johns Hopkins School of Hygiene and Public Health, Dept. of Public Health Administration**  
HOW DRIVERS PREVENTED FROM DRIVING WOULD REACH WORK: IMPLICATIONS FOR PENALTIES

HS-015 816



**Joint Hwy. Res. Proj., Lafayette, Ind.**

DESTINATION CHOICE MODELLING AND THE DIS-  
AGGREGATE ANALYSIS OF URBAN TRAVEL  
BEHAVIOR. FINAL REPORT

HS-015 751

RTOR: WARRANTS AND BENEFITS. FINAL REPORT

HS-015 752

**Joint Hwy. Res. Proj., Lafayette, Ind.**

ANALYSIS OF DRIVER REACTION TO WARNING  
DEVICES AT A HIGH-ACCIDENT RURAL GRADE  
CROSSING. FINAL REPORT

HS-015 750

**Lockheed-California Co., Burbank**

AN INTERACTIVE HYBRID TECHNIQUE FOR  
CRASHWORTHY DESIGN OF COMPLEX VEHICULAR  
STRUCTURAL SYSTEMS

HS-015 717

**Man Factors, Inc., San Diego, Calif.**

SOURCES AND REMEDIES FOR RESTRAINT SYSTEM  
DISCOMFORT AND INCONVENIENCES. FINAL  
BRIEFING

HS-801 374

**Massachusetts Inst. of Tech.**

THE USE OF CONDENSATION TECHNIQUES FOR  
SOLVING DYNAMICS PROBLEMS

HS-015 720

**Michigan State Univ., East Lansing**

THE FLEXIBILITY OF A TUBULAR WELDED JOINT  
IN A VEHICLE FRAME

HS-015 730

**Michigan State Univ., East Lansing. Highway Traf.  
Safety Center**

DWI LAW ENFORCEMENT TRAINING PROJECT.  
EVALUATION AIDS PACKET AND MEDIA LOG

HS-801 345

**Michigan Univ., Ann Arbor. Hwy. Safety Res. Inst.**

DISCUSSION (THE HSRI DUMMY COMPARED WITH  
GENERAL MOTORS BIOFIDELITY RECOMMENDA-  
TIONS AND THE HYBRID 2 DUMMY)

HS-015 695

HUMAN CHEST IMPACT PROTECTION CRITERIA

HS-015 696

IN-DEPTH ACCIDENT DATA AND OCCUPANT PRO-  
TECTION--A STATISTICAL POINT OF VIEW

HS-015 675

**Minicars, Inc.**

AN INEXPENSIVE AUTOMOBILE CRASH RECORDER

HS-015 673

**Minicars, Inc., Santa Barbara, Calif.**

TEST SLED SIMULATION OF CRASH INDUCED YAW  
AND PITCH

HS-015 693

**Minicars, Inc., 35 La Patera Lane, Goleta, Calif.**

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM.  
PROGRESS REPORT, SEPTEMBER 1974

HS-801 361

**Minicars, Inc., 35 La Patera Lane, Goleta, Calif. 93017**

INFLATABLE BELT DEVELOPMENT FOR SUBCOM-  
PACT CAR PASSENGERS. PROGRESS REPORT, SEP-  
TEMBER 1974

HS-801 369

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM.  
PROGRESS REPORT, AUGUST 1974

HS-801 367

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM.  
PROGRESS REPORT, JULY 1974

HS-801 368

**Minicars, Inc., 35 La Patera, Goleta, Calif. 93017**

SUBCOMPACT CAR CRASHWORTHINESS PROGRAM.  
PROGRESS REPORT, NOVEMBER 1974

HS-801 377

**Ministry of Transport, Road Transport Div., Wellington,  
New Zealand**

FLEXIBLE WORKING HOURS. A STUDY OF AN EX-  
PERIMENT IN FLEXIBLE WORKING HOURS TO  
DETERMINE CHANGES IN TRAVEL PATTERNS

HS-015 758

AN ANALYSIS OF TRAFFIC ACCIDENTS IN NEW  
ZEALAND

HS-015 759

THE EFFECT ON TRAFFIC ACCIDENTS OF EX-  
TENDED TRADING HOURS AT HOTELS

HS-015 760

**National Aeronautical Establishment, Ottawa, Ont.  
(Canada)**

A PROCEDURE FOR THE PHOTOMETRIC DETER-  
MINATION OF HEADLAMP AIM BY ISOLUX CON-  
TOUR MATCHING

HS-015 698

**National Hwy. Traf. Safety Administration, Washington,  
D. C.**

AUTOMOTIVE RECORDER RESEARCH--A SUMMARY  
OF ACCIDENT DATA AND TEST RESULTS

HS-015 672

THE EFFORTS OF THE NATIONAL HIGHWAY TRAF-  
FIC SAFETY ADMINISTRATION IN THE DEVELOP-  
MENT OF ADVANCED PASSIVE PROTECTION  
SYSTEMS AND CHILD RESTRAINT SYSTEMS

HS-015 686

HIGHWAY SAFETY PROGRAM MANUAL. VOL. 7.  
TRAFFIC COURTS

HS-801 349

A CONTEMPORARY OVERVIEW OF TRAFFIC LAW  
UNIFORMITY IN THE UNITED STATES. A STUDY  
PREPARED ON RULES OF THE ROAD UNIFORMITY  
IN THE TRAFFIC LAWS OF THE SEVERAL STATES

HS-820 262

**National Research Council Canada. National  
Aeronautical Establishment, Ottawa, Ont. (Canada)**

PROCEDURES AND TECHNIQUES FOR PHOTOMET-  
RIC MEASUREMENT OF GONIOMETER-MOUNTED  
SAE AND ECE HEADLAMPS

HS-015 800

**Nissan Motor Co. Ltd., Yokohama (Japan)**

STUDY ON AIR BAG SYSTEMS FOR NISSAN SMALL-  
SIZED CARS

HS-015 683

May 31, 1975

**North Carolina Univ., Chapel Hill. Hwy. Safety Res. Center**

DRIVER INJURY IN AUTOMOBILE ACCIDENTS INVOLVING CERTAIN CAR MODELS: AN UPDATE

HS-015 668

SIMULATION: ITS ROLE IN DRIVER RESEARCH AND HIGHWAY DESIGN. VOL. 8

HS-015 736

**Office of Naval Research, Washington, D. C.**

AN INTERACTIVE HYBRID TECHNIQUE FOR CRASHWORTHY DESIGN OF COMPLEX VEHICULAR STRUCTURAL SYSTEMS

HS-015 717

**Road and Motor Vehicle Traffic Safety, Ministry of Transport, Canada**

ALCOHOL AND HIGHWAY SAFETY. ROADSIDE SURVEYS OF DRINKING-DRIVING BEHAVIOR: A REVIEW OF THE LITERATURE AND A RECOMMENDED METHODOLOGY

HS-015 823

**Safety Management Inst., Suite 709, 1660 L St., N. W., Washington, D. C. 20036**

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF FLORIDA, 1971 ACCIDENT YEAR

HS-015 741

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF UTAH. 1971 ACCIDENT YEAR

HS-015 742

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF VERMONT. 1971 ACCIDENT YEAR

HS-015 743

**Safety Management Inst., 1660 L St., N. W. Suite 709, Washington, D. C. 20036**

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. COMMONWEALTH OF PUERTO RICO. 1971 ACCIDENT YEAR

HS-015 771

**Safety Management Inst., 1660 L St., N. W., Suite 709, Washington, D. C. 20036**

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF WASHINGTON. 1972 ACCIDENT YEAR

HS-015 744

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF WYOMING. 1971 ACCIDENT YEAR

HS-015 745

**Safety Management Inst., 1660 L St., N.W., Suite 709, Washington, D. C. 20036**

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF WISCONSIN. 1973 ACCIDENT YEAR

HS-015 775

**Safety Management Inst., 1660 L St., N.W., Suite 709, Washington, D. C. 20036**

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF MINNESOTA. 1972 ACCIDENT YEAR

HS-015 772

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF MISSOURI. 1972 ACCIDENT YEAR

HS-015 773

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF MONTANA. 1972 ACCIDENT YEAR

HS-015 774

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF MISSOURI. 1971 ACCIDENT YEAR

HS-015 807

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF NEW MEXICO. 1972 ACCIDENT YEAR

HS-015 808

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF NEVADA. 1972 ACCIDENT YEAR

HS-015 809

**Safety Management Inst., 1660 L St., N.W., Washington, D. C. 20036**

CONVERSION OF STATE ACCIDENT DATA TO UNIFORM ACCIDENT DATA TAPE FORMAT. STATE OF OKLAHOMA. 1971 ACCIDENT YEAR

HS-015 806

**Society of Automotive Engineers, Inc.**

INTERNATIONAL CONFERENCE ON OCCUPANT PROTECTION (3RD) PROCEEDINGS, TROY, MICHIGAN, JULY 10-12, 1974

HS-015 670

INTERNATIONAL CONFERENCE ON VEHICLE STRUCTURAL MECHANICS: FINITE ELEMENT APPLICATION TO VEHICLE DESIGN, PROCEEDINGS, DETROIT, MICHIGAN, MARCH 26-28, 1974

HS-015 706

**Solid Mechanics Div., Univ. of Waterloo (Canada)**

APPLICATION OF GRID SELECTION PROCEDURES FOR IMPROVED FINITE ELEMENT STRESS ANALYSIS

HS-015 726

**Southwest Res. Inst., 8500 Culebra Rd., P.O. Drawer 28510, San Antonio, Tex. 78284, Dept. of Automotive Res.**

INJURY ASSESSMENT OF BELTED CADAVERS. PROGRESS REPORT NO. 3, SEPTEMBER 1974

HS-801 376

**Southwest Res. Inst., 8500 Culebra Rd., P.O. Drawer 28510, San Antonio, Tex. 78284, Dept. of Automotive Res.**

INJURY ASSESSMENT OF BELTED CADAVERS. PROGRESS REPORT NO. 4, OCTOBER 1974

HS-801 375

**Sperry Rand Corp., Philadelphia, Pa.**

BARBI, A NEW RADAR CONCEPT FOR PRECOLLISION SENSING

HS-015 680

**Sperry Rand Corp., Philadelphia, Pa. Sperry Systems Management Div.**

DIGITAL COMPUTER

HS-015 770

**Stanford Res. Inst. Poulter Lab.**

SCALE MODELING OF VEHICLE CRASHES--TECHNIQUES, APPLICABILITY, AND ACCURACY; COST EFFECTIVENESS

HS-015 692

**State Univ. of New York, Stony Brook**

AUTOMOBILE COLLISIONS. A MODULE ON ENERGY AND MOMENTUM

HS-015 746

**Staten Island Community Coll., N. Y.**

AUTOMOBILE COLLISIONS. A MODULE ON ENERGY AND MOMENTUM

HS-015 746

**Structural Dynamics Res. Corp., Cincinnati, Ohio**

NASTRAN FOR DYNAMIC ANALYSIS OF VEHICLE SYSTEMS

HS-015 716

**Takata Kojyo Co. Ltd. (Japan)**

DEVELOPMENT OF ENERGY-ABSORBING SAFETY BELT WEBBING

HS-015 687

**Technische Hochschule, Munich (West Germany)**

INFLUENCES ON THE DRIVING BEHAVIOR OF AUTOMOBILES (EINFLUSSE AUF DAS FAHRVERHALTEN VON KRAFTFAHRZEUGEN)

HS-015 702

**Texas A and M Univ., College Station. Aerospace Engineering Dept.**

SURVEY OF SOLUTION PROCEDURES FOR NON-LINEAR STATIC AND DYNAMIC ANALYSES

HS-015 707

**Texas Transportation Inst., Texas A and M Univ.,**

College Station, Tex. 77843

CRASH TESTS AND EVALUATION OF SINGLE POST HIGHWAY SIGNS. INTERIM REPORT

**Transport Systems, Transport and Road Res. Lab., Crowthorne, Berks., England**

SPEED/FLOW RELATIONS ON RECREATIONAL ROADS

HS-015 783

**Ultrasystems, Inc., Dynamic Science Div., 1850 West Pinnacle Peak Road, Phoenix, Ariz. 85027**

VEHICLE BRAKING SYSTEMS TEST PROCEDURE--HYDRAULIC BRAKES. FINAL REPORT

HS-801 308

**Ultrasystems, Inc., Phoenix, Ariz. Dynamic Science Div. FRONT END STRUCTURES CRASH RESPONSE CHARACTERIZATION**

HS-015 677

**Ultrasystems, Inc., Phoenix, Ariz.**

IMPROVED RESTRAINT FOR U. S. ARMY AIRCREWMEN

HS-015 690

**Univ. of Cincinnati, Cincinnati, Ohio 45221**

USER'S MANUAL FOR UCIN VEHICLE-OCCUPANT CRASH-STUDY MODEL

HS-015 769

**University of New Brunswick**

THE ROLE OF FINITE DEFORMATION ANALYSIS IN PLANE STRESS AND STRAIN FRACTURES

HS-015 722

**Virginia International Testing Labs., Inc., 1548**

Springhill Rd., McLean, Va. 22101

UNIFORM TIRE QUALITY GRADING TREADWEAR. FINAL REPORT

HS-801 315

**Virginia Polytechnic Inst. and State Univ.**

FINITE ELEMENT ANALYSIS OF AUTOMOBILE STRUCTURES

HS-015 709

**Volkswagenwerk A. G., Wolfsburg (West Germany)**

PERFORMANCE MATRICES OF FOUR RESTRAINT SYSTEMS

HS-015 689

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE CRASHWORTHINESS OF SMALL CARS

HS-015 679

## Contract Number Index

### DOT-HS-021-2-472

Safety Management Inst., Suite 709, 1660 L St., N. W.,  
Washington, D. C. 20036

HS-015 741

Safety Management Inst., Suite 709, 1660 L St., N. W.,  
Washington, D. C. 20036

HS-015 743

Safety Management Inst., 1660 L St., N. W., Suite 709,  
Washington, D. C. 20036

HS-015 744

Safety Management Inst., 1660 L St., N. W., Suite 709,  
Washington, D. C. 20036

HS-015 745

Safety Management Inst., 1660 L St., N. W. Suite 709,  
Washington, D. C. 20036

HS-015 771

Safety Management Inst., 1660 L St., N.W., Suite 709,  
Washington, D. C. 20036

HS-015 772

Safety Management Inst., 1660 L St., N.W., Suite 709,  
Washington, D. C. 20036

HS-015 773

Safety Management Inst., 1660 L St., N.W., Suite 709,  
Washington, D. C. 20036

HS-015 774

Safety Management Inst., 1660 L St., N.W., Suite 709  
, Washington, D. C. 20036

HS-015 775

Safety Management Inst., 1660 L St., N.W., Washington, D.  
C. 20036

HS-015 806

Safety Management Inst., 1660 L St., N.W., Suite 709,  
Washington, D. C. 20036

HS-015 808

Safety Management Inst., 1660 L St., N.W., Suite 709,  
Washington, D. C. 20036

HS-015 809

### DOT-HS-031-3-765

Hwy Safety Res. Inst., Univ. of Michigan, Huron Pkway. &  
Baxter Rd., Ann Arbor, Mich. 48105

HS-801 352

Hwy. Safety Res. Inst., Univ. of Michigan, Huron Pkwy. &  
Baxter Rd., Ann Arbor, Mich. 48105

HS-801 353

### DOT-HS-034-3-535

Inst. for Research in Public Safety, Indiana Univ., 400 East  
Seventh St., Bloomington, Ind. 47401

HS-801 334

Inst. for Research in Public Safety, Indiana Univ., 400 East  
Seventh St., Bloomington, Ind. 47401

HS-801 335

### DOT-HS-046-3-769

Ultrasystems, Inc., Dynamic Science Div., 1850 West Pinna-  
cle Peak Road, Phoenix, Ariz. 85027

HS-801 308

### DOT-HS-053-2-487

Calspan Corp., Buffalo, N. Y. 14221

HS-801 364

Calspan Corp., Buffalo, N. Y. 14221

HS-801 378

Calspan Corp., 4455 Genesee St., Buffalo, N. Y. 14221

HS-801 318

### DOT-HS-053-3-727

Calspan Corp., Buffalo, N. Y.

HS-801 324

Calspan Corp., 4455 Genesee St., Buffalo, N. Y. 14221

HS-801 323

### DOT-HS-099-3-747

Dunlap and Associates, Inc., Darien, Con..

HS-801 344

### DOT-HS-105-3-680

IIT Research Inst., 10 West 35 St., Chicago, Ill. 60616

HS-801 365

IIT Research Inst., 10 West 35 St., Chicago, Ill. 60616

HS-801 373

### DOT-HS-113-2-441

Minicars, Inc., Santa Barbara, Calif.

HS-015 693

### DOT-HS-113-3-746

Minicars, Inc., 35 La Patera Lane, Goleta, Calif.

HS-801 361

Minicars, Inc., 35 La Patera Lane, Goleta, Calif. 93017

HS-801 367

Minicars, Inc., 35 La Patera Lane, Goleta, Calif. 93017

HS-801 368

Minicars, Inc., 35 La Patera, Goleta, Calif. 93017

HS-801 377

### DOT-HS-230-3-674

Man Factors, Inc., San Diego, Calif.

HS-801 374

### DOT-HS-334-3-645

Michigan State Univ., East Lansing. Highway Traf. Safety  
Center

HS-801 345

### DOT-HS-4-00799

Virginia International Testing Labs., Inc., 1548 Springhill  
Rd., McLean, Va. 22101

HS-801 315

### DOT-HS-4-00865

Hwy. Safety Res. Inst., Univ. of Michigan, Ann Arbor  
48105

HS-801 384

Hwy. Safety Res. Inst., Univ. of Michigan, Ann Arbor  
48105

HS-801 385

Hwy. Safety Res. Inst., Univ. of Michigan, Ann Arbor  
48105

HS-801 386

### DOT-HS-4-00917

Minicars, Inc., 35 La Patera Lane, Goleta, Calif. 93017

HS-801 369

**DOT-HS-4-00929**

Budd Co., Technical Center, 300 Commerce Dr., Ft. Washington, Pa.

HS-801 362

Budd Co., Technical Center, 300 Commerce Dr., Ft. Washington, Pa.

HS-801 363

Budd Co., 300 Commerce Dr., Ft. Washington, Pa. 19034

HS-801 370

Budd Co., 300 Commerce Dr., Ft. Washington, Pa. 19034

HS-801 371

Budd Co., 300 Commerce Dr., Ft. Washington, Pa. 19034

HS-801 372

**DOT-HS-4-00998**

Southwest Res. Inst., 8500 Culebra Rd., P.O. Drawer 28510, San Antonio, Tex. 78284, Dept. of Automotive Res.

HS-801 375

Southwest Res. Inst., 8500 Culebra Rd., P.O. Drawer 28510, San Antonio, Tex. 78284, Dept. of Automotive Res.

HS-801 376

**DOT-HS-021-2-472**

Safety Management Inst., Suite 709, 1660 L St., N. W., Washington, D. C. 20036

HS-015 742

**FH-HPR-PR-1(9)-B0146**

California Dept. of Motor Vehicles, Sacramento, Res. and Statistics Section

HS-015 780

**FH-HPR-PR-1(9)-B0146**

California Dept. of Motor Vehicles, Res. and Statistics Section, P. O. Box 1828, Sacramento, CA 95809

HS-015 781

**HPR-1-(11)-Pt-2**

Joint Hwy. Res. Proj., Lafayette, Ind.

HS-015 750

**HPR-1-(12)-Pt-1**

Joint Hwy. Res. Proj. Lafayette, Ind.

HS-015 751

**IA-A13306**

California Dept. of Motor Vehicles, Res. and Statistics Sec-

tion, P. O. Box 1828, Sacramento, CA 95809

HS-015 781

California Dept. of Motor Vehicles, Sacramento, Res. and Statistics Section

HS-015 780

**IIHS-6540**

General Environments Corp., 6840 Industrial Rd., Springfield, Va. 22151

HS-015 802

**NRCC-A-7014**

Department of Civil Technology, Conestoga Coll. of Applied Arts and Technology (Canada); Solid Mechanics Div., Univ. of Waterloo (Canada)

HS-015 726

**NSF-GZ-9320**

State Univ. of New York, Stony Brook; Staten Island Community Coll., N. Y.

HS-015 746

**N00011-68-A-0308-0004 Grant NSF-35914**

Texas A and M Univ., College Station. Aerospace Engineering Dept.

HS-015 707

**N00014-72-C-0223**

Boeing Computer Services, Inc., Seattle, Wash.

HS-015 721

**N00014-72A-0027-0002**

Univ. of Cincinnati, Cincinnati, Ohio 45221

HS-015 769

**Ref: FH-11-6918**

Calspan Corp., 4455 Genesee St., Buffalo, N. Y. 14221

HS-801 318

**Ref: FH-11-7622**

Calspan Corp., 4455 Genesee St., Buffalo, N. Y. 14221

HS-801 318

**RS-2-10-68-146**

Texas Transportation Inst., Texas A and M Univ., College Station, Tex. 77843

HS-015 782

**TRRL-CON/3140/32**

British Leyland U. K. Ltd., England Truck and Bus Div.

HS-015 669

# Report Number Index

-SAE-740590	HS-015 697	SAE-P-52	HS-015 706
AAA-3210	HS-015 761	SAE-P-53	HS-015 670
ANSI-D6.1-1971	HS-015 822	SAE-740317	HS-015 707
CAL-DMV-RSS-74-46	HS-015 781	SAE-740318	HS-015 708
CTS-1b-74	HS-015 823	SAE-740319	HS-015 709
D6080-13	HS-801 365	SAE-740320	HS-015 710
D6080-14	HS-801 373	SAE-740321	HS-015 711
ED-74-12	HS-801 344	SAE-740322	HS-015 712
Goodyear-Contrib-517	HS-015 810	SAE-740323	HS-015 713
GEC-A-4348.2	HS-015 802	SAE-740324	HS-015 714
GMR-1701	HS-015 755	SAE-740325	HS-015 715
HLDI-A-2	HS-015 735	SAE-740326	HS-015 716
IRPS-DOT-HS-034-3-535-73-TAC	HS-801 334	SAE-740327	HS-015 717
	HS-801 335	SAE-740328	HS-015 718
JEP-74-14	HS-015 752	SAE-740329	HS-015 719
JHRP-74-15	HS-015 751	SAE-740330	HS-015 720
JHRP-74-16	HS-015 750	SAE-740331	HS-015 721
LIKENNETURVA-15	HS-015 784	SAE-740332	HS-015 722
LTR-ST.720	HS-015 698	SAE-740333	HS-015 723
LTR-ST-610	HS-015 800	SAE-740334	HS-015 724
ONR-US-EA-050174-2-TR	HS-015 769	SAE-740335	HS-015 725
PB-202 365	HS-015 770	SAE-740336	HS-015 726
Ref: UM-HSRI-SA-734	HS-015 757	SAE-740337	HS-015 727
RR-146-11	HS-015 782	SAE-740338	HS-015 728

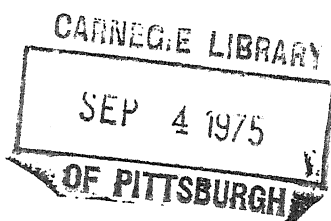
SAE-740339	HS-015 729	SAE-740583	HS-015 688
SAE-740340	HS-015 730	SAE-740584	HS-015 689
SAE-740341	HS-015 731	SAE-740585	HS-015 690
SAE-740342	HS-015 732	SAE-740586	HS-015 691
SAE-740343	HS-015 733	SAE-740587	HS-015 692
SAE-740344	HS-015 734	SAE-740588	HS-015 693
SAE-740565	HS-015 671	SAE-740589	HS-015 694
SAE-740566	HS-015 672	SWRI-11-4019	HS-015 696
SAE-740567	HS-015 673		HS-801 375
SAE-740568	HS-015 674	Traf-Res-Cir-5	HS-801 376
SAE-740569	HS-015 675	TR-69-012(004)	HS-015 759
SAE-740570	HS-015 676	TRRL-LR-638	HS-015 776
SAE-740571	HS-015 677	TT-72-55007	HS-015 783
SAE-740572	HS-015 678	TTI-2-10-68-146-11	HS-015 702
SAE-740573	HS-015 679	UM-HSRI-BI-74-5	HS-015 782
SAE-740574	HS-015 680	UM-HSRI-PF-74-13-1	HS-801 384
SAE-740575	HS-015 681	UM-HSRI-PF-74-13-2	HS-801 352
SAE-740576	HS-015 682	UM-HSRI-SA-74-7	HS-801 353
SAE-740577	HS-015 683	ZM-5177-M	HS-015 803
SAE-740578	HS-015 684	ZM-5177-V	HS-801 364
SAE-740580	HS-015 686	ZM-5177-V-3	HS-801 378
SAE-740581	HS-015 687	ZM-5350-K-1	HS-801 318
SAE-740582		ZM-5350-K-2	HS-801 323
			HS-801 324

B5 



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